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ABSTRACT

Abstracts of the following 52 papers are included in this document: "Development of a Computer-Automated Mechanical Testing System" (Aman); "Bringing Industry High-Tech into the School Curriculum" (Andrews); "Fostering Excellence in Industrial Technology Faculty and Programs" (Bensen); "World Markets and Industrial Technology" (Carlson); "Applied Technical Research" (Cheng et al.); "Industrial Safety" (Colling); "Technical Art for Industry" (Dye); "Improving on Work Standards in Construction" (Egger); "A Partnership between Industry and the University" (Leeper, Eversoll); "New Material Trends in Construction" (Lovata, Fahmy); "Non-Destructive Evaluation of Industrial Products" (Fahmy); "Automatic Identification" (Fales, Little); "FMS Effect on IT Core Courses" (Fillman); "Solar Energy Research at ISU" (Francis); "Mobile Computers" (Fryda); "Configuring a Data Acquisition, Control and Networking System for Factory Automation" (Gedeon); "Strategies for Change" (Grannis); "Technological Education and National Development in Zimbabwe" (Hatch); "Foreign Manufacturers Are Causing Turmoil for American Buyers" (Herendeen); "Social Impact of Technological Change" (Holloway); "Basic Supervisory Training" (Horton); "Just-in-Time Production System" (Izadi); "Statistical Process Control" (Jawahar); "Automatic Communications between 'Intelligent' Machines" (Jellema); "Energy Management Control Systems" (Kale); "CAD Systems for Smaller Schools/Industries" (Koie); "The Global Influence" (Kruppa); "Color Imaging Technology" (Liedtke); "The Illinois Plan for Industrial Education" (Loepp); "Graduate Education in Industrial Technology" (McLuckie, Sutton); "A User versus a Doer" (Mackey, Sterzik); "Planning for Mid-Volume, Mid-Variety Parts Production" (Maleki); "United States Technology Transfer" (Markert); "Just-in-Time Manufacturing" (Meyers); "Statistical Process Control" (Miller, Schmitz); "Earth Sheltered Residential Construction" (Perreault); "Applied Composite Technology in the Aircraft Industry" (Riley); "Geometric Dimensioning and Tolerancing" (Routh); "Artificial Intelligence" (Roy, Sutton); "Information Online for Technology Education" (Schack); "Energy Literacy" (Singletary); "Managing Industrial Technology Programs in a Multi-Purpose Academic Unit" (Streichler); "Microcomputer Graphics Animation" (Tolu-Honary); "Robotics and the Future of Manufacturing" (Trivedi); "Implementing Japanese Soft Technology in the IT Curriculum" (Vail); "Port Fuel Injected Turbo-Charged Engines" (Weathers); "The Implication of the Construction Industry Cost Effectiveness Project Report" (Weeks); "Expert Systems in Industrial Operations Management" (Weerasekera); "Team Building Technology" (White); "Integrated Technologies" (Winchip); "CAD Education Utilizing the Macintosh Computer" (Wood); and "Upgrading Technical Competency by Shadowing" (Yung). (KC)

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Technology: A Global Influence

Conference Proceedings

19th Annual Conference of the National Association of Industrial Technology

October 8, 1986
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Illinois State University
College of Applied Science and Technology
Department of Industrial Technology

Dear Conference Participant:

Contained within these proceedings are abstracts for the refereed presentations that will be made at the 19th Annual NAIT Conference. Presenters were chosen based on applications submitted in response to a "Call for Papers" last spring. At the close of applications on April 11, 1986, forty-nine presentations were selected from ninety-eight requests received.

Members of the Presentation Evaluation Panel were: Dr. Stanley Aman, Dr. Lawrence Fryda, Dr. Gene Gloeckner, Dr. Everett Israel (Coordinator), Dr. Jane Liedtke and Mr. Galen Winchip. Applications were judged based on the following published criteria:

- Appeal to industrial technology faculty, industrial technology students, and to industrial personnel.
- Quality of presentation as determined by the written application.
- Focus on contemporary topics and techniques with special consideration given to presentations that tie directly to the Conference Theme -- "Technology: A Global Influence."

On behalf of the National Association of Industrial Technology and the entire conference planning committee, may we express our sincere appreciation for all of those that submitted applications; for the work of the Presentation Evaluation Panel members; and for the presenters selected to share in providing the technical presentations program. It is our belief that this commitment by many will significantly benefit our profession.

Sincerely,

Wayne Andrews
Hank Campbell
Larry Miller, Conference Co-Chairpersons

Normal-Bloomington, Illinois
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Development of a Computer-Automated Mechanical Testing System

Dr. Stanley G. Aman
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Normal, Illinois

ABSTRACT

An integral step in the manufacturing of goods is the selection of the materials to be used. Material selection is to a large degree based on the physical, mechanical, and chemical properties which effect the economics of production and the serviceability of the final product. The commonly accepted standards for determining these properties have been developed by the American Society for Testing and Materials (ASTM).

Four of the tests which are commonly performed during materials selection are tensil, shear, hardness, and compression. Each test yields comparative mechanical properties of a material. The tests are conducted by applying a controlled mechanical force or load to the test specimen, and measuring the change in physical shape or size as a result of the load. The load applied to the specimen is termed stress (measured in force per unit area), while the change in shape or size is termed strain (measured as deformation per unit of original length). By applying a load or stress to a test specimen at regular increasing intervals, and measuring the resulting change in shape or strain at each load interval, a series of stress-strain points can be plotted as a graph. The resulting graph, called a stress-strain diagram, allows the designer to determine the apparent stiffness or rigidity of the material, termed modulus of elasticity, as well as the maximum serviceable strength, termed the proportional limit. These properties can then be utilized during the design process in order to evaluate the suitability of the material for the service environment, as well as the required quantity of material in order to provide sufficient strength.

The laboratory instrument commonly used for testing the mechanical properties of a material is a Universal Testing Machine (UTM). The machine consists of a weighing table which is either mechanicaly driven or hydraulically loaded, dependent upon the type of machine used. The speed of travel and load exerted by the weighing table are often controlled manually by the researcher. In the case of many of the test procedures identified by ASTM, the speed of loading is specified, and can be nearly impossible to control manually with sufficient accuracy.

In addition to controlling the loading parameters of the machine, the researcher must also be able to record the load being applied as well as the resulting change in size of the specimen. Both the controlling of the machine and the recording of experimental data must take place according to actual or real-time intervals.

One method of facilitating the control and data recording processes during the materials testing is to employ a computer-automated control and monitoring system in conjunction with the Universal Testing Machine. A specially designed computer system can be used to precisely control and monitor the loading conditions of force and speed of loading, while simultaneously monitoring the change in size of the test specimen. A computer-automated system can accurately monitor and control conditions which occur at very high rates of speed. Further experimental advantage lies in the ability to pre-program complex cyclical loading patterns or conduct tests over extended periods of time as is required when testing a prototype product. Since the computer system is responsible for recording the experimental data, the potential for human error during the recording and transcription processes is greatly reduced.

Upon completion of a test, the experimental data stored in the computer can be subsequently reduced and analyzed. A statistical data summary can be presented to the researcher, along with a variety of graphic representations of the experimental data.

The use of a computer-automated experimental testing system affords the opportunity to conduct tests which would be impossible or unreasonable utilizing manual experimental methods. The speed and accuracy of the computer allows data collection and control at the highest statistical levels, and allows for the collection of large quantities of data points in real-time. The traditional role of computers as a data storage, reduction, analysis, and presentation tool facilitates the interpretation of experimental test data.

This presentation will consist of a technical overview and demonstration of a computer-automated system for evaluating the mechanical properties of industrial materials. The demonstration will show the functional capabilities of integrating a Universal Testing Machine with a computer-based monitoring and control system.

Bringing Industry High-Tech Into The School Curriculum

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ABSTRACT

High technology information, especially where it deals with industry has been non-existent or inadequately represented in most technical course instruction. Students exposure to industry is usually very limited and the pace of technological developments has produced an ever-widening gap between our present level of technical instruction and the practices and applications of high-tech in industry and our society. This problem impacts industry, teachers, administrative and curriculum personnel and especially the students being prepared for their respective occupations. Finding a solution to meet these needs would seem to deserve our immediate attention. The hypothesis presented for resolution of this problem involves the development of a feasible, cost effective process for updating technical curricula involving utilization of current appropriate media such as printed and audio-visual materials. Schools that are located considerable distances from manufacturing industry concentrations are especially unable to cope with this problem except possibly through the use of media consortia, computer terminals, or satellite receivers linked to a central media bank.

Specifically, these media materials could help provide an increased quality, quantity and level of technical instruction, increased knowledge of current high technology applications, occupational opportunities, and help in the identification of the need and provision for further student and teacher training.

Development of a national media bank containing current media materials obtained from industry and other sources, linked by phone lines and/or satellite to schools throughout America and possibly the world, could fulfill an important need in technical course instruction.

Obviously, before developing a system of national or international scope, development work needs to be accomplished at the local and/or state-regional level. Communities with high-tech industries and available technical programs would be good candidates for such initial development programs. High-points of a proposal example to accomplish this are given during the presentation.

After a brief introduction, the present needs of high-tech media materials in the school instructional program are examined during the presentation as to the involvement of the following: consortia, computers, networks, cognitive levels, problem solving, systems, software, and industry-school cooperation.

Applications and discussion are next presented from literature sources dealing with the preceeding topics from a present and future time frame. The importance of intrinsic motivation and the self-directed (independent) learner are then considered along with the "rote" curriculum so much a part of our present instructional efforts. Because of the complexity of the problem no attempt is made to present in-depth research of the many facets that are involved in this seemingly simple problem. Instead, it was decided to pursue a more formative approach by examining a number of related sources and using excerpts to provide possible substantiation of this problem as being both timely and critical in nature. In addition, to the problems complexity there are limited helpful research findings to

help construct pragmatic solutions to subproblems such as learning, cognitive levels, intrinsic motivation, systems, and network technology.

The need for a process rather than a product emphasis is considered in terms of growing concern for adequately preparing students for more effective integration into their chosen occupation.

New developments for Industrial America such as artificial intelligence, interactive videodiscs, voice recognition systems, and robots are mentioned and a challenge issued as to how we in education can best take advantage of these emerging technologies and adapt them to our needs. Their effect on the educational process is also briefly mentioned along with the challenge of developing effective educational methodology systems.

Productivity, which involves the three components of manpower, equipment, and systems are presently not in balance. This has occurred primarily because over the past few decades, technology has been vigorously applied to equipment and systems but not to the manpower component. The implications and some possible solutions for rectifying this situation are identified. High-tech information is briefly looked at in terms of its availability from industry, private, public, and commercial sources. Some recent attempts at delivering high-tech information through such avenues as consortia, and electronic networks from local to international levels are examined as to their degree of success, limitations, and need for further development. A few of the more recent technical advances having direct implications for needed improvements in networks are presented to illustrate the dynamic relationships of systems and emerging technology.

The challenge and opportunities presented by this problem are considered together with the excellent benefits that could result from a successful solution for bringing industry high-tech into the school curriculum. Better school-industry partnerships are examined as to their role in helping achieve better integrated educational systems for maximum goal attainment. Better preparation of the learner to successfully operate at the higher cognitive levels of problem solving and creativity is also considered. Considerations for participant motivation and involvement are given as ways to enhance the production system success and efficiency.

Time permitting, a discussion period will be held at the close of the formal presentation for audience participation and discussion of the topics presented.

Fostering Excellence in Industrial Technology Programs

Dr. M. James Bensen
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Menomonie, Wisconsin

ABSTRACT

Introduction

In order to remain relevant and meet the needs of industry, Industrial Techology Programs require constant development and attention to detail. It is understood that the curriculum must be kept current, faculty up to date, and the facilities up to standard. There are a number of ways of doing this, however, this paper will outline some successful ventures that have been experienced at Stout.

Innovation in Program Management & Direction

Leadership for programs is the responsibility of a Program Director. Meeting with a cross-disciplinary committee, made up of both on and off-campus people the curriculum is designed and approved through university channels. All recruitment, advisement, accreditation, certification, and follow up is managed out of this office. The Program Director reports directly to the Dean's Office rather than to a department.

A Program Design and Philosophy

The program is designed with a particular philosophy that is consistent with that which has emerged in the field of industrial technology. A core of "professional studies" that are required of all majors and a "basic technology" sequence are a common component. The general education component requires a series of typical courses in humanities, a year and a half of English, a full year of speech, math through calculus, additional statistics and computer courses, and fifteen credits of science.

Concentrations are then encouraged, which permit students to specialize in a particular field. Fifteen concentrations such as manufacturing engineering, packaging, plant engineering, product design, etc., provide the graduate direct entry into the work world with outstanding placement and success.

Research & Development Centers

Several R&D centers are used to generate interaction with industry and other organizations. These centers work with departments to assist in obtaining grants for extramural work. Seven centers are in operation to work with corporate and governmental sources of interaction.

Adjunct Industrial Professors

This past year 24 people from industry were named to adjunct professor appointments. These people were supported by industry and spent from one to five days a week on campus. The roles that are served range from full time teaching to research and development. Examples of people who serve in this capacity are the former head of a Fortune 500 Company's "think tank", Vice President for International Marketing, president of a research and development firm, and a Corporate Vice President for Manufacturing.

High Technology Seminar

Each Wednesday afternoon a seminar is run with an engineer or scientist from industry making a presentation on a "cutting edge" technological development. Undergraduate students can choose to enroll, audit, or sit in on topics of special interest. Faculty and area industrialists are invited to sit in on the seminar as well.

Cabot Executive in Residence

A CEO from a major corporation is invited to come on campus for a day to interact with students, faculty and administration. This is followed with a major presentation to the university and community on a topic of the "executive's" choice.

Industrial Problems as Class Projects

Live projects from industry are solicited to use in classes of all types. Manufacturing design, software development, land use planning, prototype development, product testing, marketing studies, etc., are examples of these projects. Solutions are, in turn, presented to the corporation that "sponsored the problem".

Student Organizations

Much attention and effort is expended to supporting student organizations. The school sponsors 18 clubs, many with "chapter affiliation".

Advisory Committees

Advisory committees and boards are used both at the all university level and at the unit level. These committees have been directly responsible for curriculum update and several hundred thousand dollars worth of support each year.

Experiential Learning

Field Experience, Internship, and Co-op Programs are used heavily to support and augment the education that takes place on campus. Hundreds of students are placed in sites across the country and some in company assignments in international settings.

Incubators

New companies are "incubated" on campus as start-up ventures. These companies are placed in a "sheltered", yet resource rich environment, and are permitted to stay for up to three years. Students and faculty work closely in assisting in developing these private companies.

World Markets and Industrial Technology: Challenge of the Future

Mr. Wallace C. Carlson Jr.
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Menomonie, WI

ABSTRACT

World markets and international trade are at the forefront of our nation's technological and industrial attention. Our international prestige, national sense of accomplishment, and investment in future national economic growth and strength hinge in significant measure on the competitive ability of our technology and industry. During the last three decades, the United States has lost large shares of both its domestic and foreign markets to technologies and industries of other established or developing nations. Many contrasting suggestions and proposals have been advocated to regain our competitive stature in international technology and industry or to contain what are seen as "intrusions" into traditional American markets. These suggestions range from "protectionists" proposing restriction of trade within targeted domestic technologies and markets to "open-market" proponents advocating that technology and markets should be free and unencumbered by restraint or government action.

Both protectionist and open market proposals have significant implications for the nation's industry and technology. Often protectionists measure the "adverse" impact of foreign trade on national markets from a narrow, special interest view. They will acknowledge that if special barriers or impediments are erected to protect their individual interests or segments in U.S. markets, a very real possibility exists that reciprocal barriers would be erected against U.S. industries currently enjoying a strong international trade position. The across-the-board effect of protectionism would probably benefit a few to the detriment of many, result in unproductive use of resources, misapply effort and deaden the pace of necessary change. The U.S. steel industry is a classic study in the possible effects of protectionism.

Correspondingly, a blanket open market offers many difficulties. As an example, the United States leads the world in expenditures for research and development. In the past 15 years annual R&D expenditure in the U.S. has increased from $20 to over $50 billion. Japan's government and industries have entered into some 32,000 licensing agreements to obtain the right to use foreign, mainly U.S., technological and industrial advances. Estimated costs to the Japanese to obtain the rights to these

advanced technologies and processes is $9 billion dollars. This brings disproportionate benefit to Japan. The benefit is further compounded by a U.S. failure to obtain reciprocal "open market" agreements; agreements as to where the acquired U.S. technology is to be used; or control on the use of acquired U.S. technology and processes against U.S. technology and industry in international trade.

U.S. industry requires some scrutiny. It would be assumed that the nation that pioneered and developed numerically controlled machines would be a world leader in using these machines, yet a survey of manufacturers in 1978 indicated that only 31% of U.S. machine tools were less than 10 years old; this corresponds with the machine tool stock average age found after 10 years of the great depression in 1940.

The unequivocal national response to technological and industrial competition in world and domestic markets has yet to be formed or decided upon. However, many actions and responses are being recommended and currently undertaken. IBM provides one contemporary example of response to foreign trade and industry. In 1985, Americans bought four million low-priced computer printers; 80% of them were manufactured in Japan. Taking a technology developed in the U.S. by IBM, Japanese industry innovated on basic design and technology, increased product manufacturability and reliability, significantly reduced costs, and marketed effectively in a $2 billion-plus retail market. IBM responded to this increasing technological and industrial competition and in the late 1970s established a corporate goal: to become the world's lowest-cost producer of computers and computer related equipment. Using the latest in manufacturing processes and techniques, even some techniques developed in Japan, IBM has created a new manufacturing facility for low-cost printers and has completely rebuilt existing facilities for typewriter production, portable personal computer and color monitor assembly. IBM is taking on its competition, many of whom were once suppliers to IBM, in a head-to-head manner that few American companies can match or afford.

This presentation will address the relationships between world markets and technology and examine how this relationship continues to influence industrial technology. The relationship of world markets and technology will be approached multi-dimensionally. Concepts and issues directly affecting the orientation of the national technological base will be integrated. Possible responses to the changing international technological and industrial environment will be considered.

"Applied Technical Research: Key to the Future for Industrial Technology"

Dr. Wan-Lee Cheng
California State University
San Francisco, CA

Dr. David Gedeon
Bowling Green State University
Bowling Green, OH

Dr. Luvern Eickhoff
University of North Dakota
Grand Forks, ND

Dr. John Sinn
Bowling Green State University
Bowling Green, OH

Abstract

American Industry must rely heavily on research and development to provide new processes, products and innovation for the future. This is particularly true when considered from the perspective that foreign competitors are increasingly providing improved products for the global market. This need in American industry must be met in part through systematic faculty and student research efforts in industrial technology. Background on the problem, the current analysis, benefits to our programs, stategies and approaches for enabling applied technical research, and exemplary case studies constitute the remainder of this presentation.

Background on the Problem

Although it is true that the macro view of the problem is the need for industrial technology to help address research and development in industry, on the micro level the writers have identified a much more pragmatic problem to address. The problem is that at universities all across America, industrial technology faculty are being compared for tenure and promotion against standards which are determined (and often controlled) by the classic sciences (i.e., physics, chemistry, psychology, etc.). More and more, candidates are advancing out of departments and colleges, but being denied tenure and promotion at the university-level due to our inability to compete effectively with traditional "science" standards. Although this problem is being addressed at the micro level, it is also assumed that improvements on the macro level presented earlier may also likely result.

A second major part of the problem being pursued by the writers is that industrial technologists may simply not understand what may be appropriate for technical research pursuits. That is, industrial technologists may simply not know what their focus is for applied technical research purposes. Several areas are suggested here, to be pursued further in the presentation. These could include materials, processes, management issues, quality, productivity, among others.

The Current Analysis

It appears fair to say that many people associated with industrial technology have their roots in industrial education and teacher preparation. The purpose here is not to provide an in-depth analysis of these roots. However, as these roots relate to applied technical research it may be worthwhile to provide some analysis. Coming out of a teacher preparation background, we have placed a heavy emphasis on classroom teaching rather than research. This emphasis continues placing heavy demands on faculty time and other resources such as equipment, funds, and graduate assistant time. When considering a possible research project today it is very common to hear a request for release time. This is virtually impossible since most programs have heavy demands on their teaching time. The teacher preparation background has also caused many of us to look at descriptive and developmental research methods (e.g., surveys, historical analysis) rather

than experimental or comparative methods. Likewise, we tend not to be comfortable with statistical procedures and strategies for designing studies and measuring for significant results. This possible weakness in our background also shows up in terms of lack of exposure to hard sciences, and certainly a lack of exposure to applied technical research. This perspective simply was not necessary for teacher preparation programs.

Other current factors affecting our ability (or lack of) to conduct applied technical research could include:

1. Lack of funding and lack of skills necessary for obtaining funding.
2. Our generalist background.
3. Lack of systematic discipline toward a limited area of technical focus.

Benefits and Improvements in Programs

It appears quite clear that a systematic approach to applied technical research will benefit our programs in numerous ways. Among those are the following:

1. Increased likelihood of tenure and promotion for faculty based on an improved ability to compete effectively across campus regarding traditional criteria.
2. Improved general posture and status accross campus due to a more obvious credibility.
3. Improved alignment between goals of our programs and the fundamental philosophy of most universities/colleges/departments.
4. Improved position to conduct "hard" research for funding agencies, both public and private.
5. Improved position with industry in terms of student placement, equipment donations, and possibly other opportunities, the least of which may include applied research.
6. Enhanced general perception by the public, i.e., improved public image.

Getting Applied Technical Research Started

Successful applied research activities will require several appropriate circumstances in order to make it happen. Some of these circumstances are identified in the following section according to the areas of (1) managing, (2) graduate, and (3) teaching. By way of managing, it is important to focus on one or possibly two areas of interest at most. Although this requires discipline, it will help accomplish the technical research objectives. Effective management will also seek to obtain release time, and will encourage team work both within departments and interdisciplinary programs. From a graduate emphasis, we must pursue seed money along with graduate students, both to enable their projects, but also to accomplish our aims. In fact, it appears very appropriate to simply require specific graduate students to conduct specific parts of faculty research with appropriate guidance given by faculty. This may also apply to undergraduate students as well. Relating to teaching, it appears prudent to focus research efforts only in areas which you are responsible for teaching, hopefully enhancing individual productivity. Also related to teaching and without attempting to seem overly impetuous, it may be necessary for some of us to de-emphasize teaching to some extent in the future. This may be true since many of us have simply always focused only on teaching in the past, putting our entire emphasis in this area. It is now time to put a reasonable amount of our energy into research.

Summary

Based on the above background, the central focus of this presentation, beyond the space permitted in this two page abstract, is to provide specific guidance to industrial technology faculty as related to applied technical research. The authors will address how to conduct the research as well as how to obtain funding and how to report results of research efforts. In all cases, specific case studies will be used from the authors' experiences and their own research efforts.

Use of the Microcomputer to Handle the Statistical Control Charts

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ABSTRACT

I. INTRODUCTION

Statistical Quality Control (SQC) is a branch of total quality control practice. It is a technique used for monitoring, evaluating, analyzing, and interpreting a manufacturing process. Therefore, inheretive variations can be identified, causes of problems can be determined and corrected.

Control chart method is one of the most powerful tools for analysis and presentation of data in statistical quality control. Engineers, as well as job operators can easily visualize the progress situation by quick review of the plotted curve. There are several different kinds of charts commonly used in the manufacturing industry depending upon the quality characteristics examined and the type of data collected. For variables, measurable data, such as a dimension, cost, resistance or hardness, average ($\bar{x}$) and range (R) charts are usually applied to a period of time in terms of the stability of a process.

II. BASIC CONCEPTS

Control chart concepts are primarily based on the sample statistics and the Central Limit Theorem. When a population study of 100% inspection is not practical, studying groups of small samples in a continuous and sequential manner will be able to indicate the characteristics of the populations. Furthermore, the sample's behavior which occurs during the study interval will reflect the manner of variations either by a chance or a constant cause.

It is a fact that variation is inherent in all manufacturing processes and is measurable in many instances. In a long run, those industrial variations tend to conform to the normal distribution. Any indication beyond the $\pm 3\sigma$ due to variation is most likely signalling a definite cause of possible problem which needs to be removed. In this case, the operation under observation is considered to be in an out-of-control condition. On the other hand, if sample statistics values plotted on a control chart are considered to be in control, the points will fall within the control limits and show no patterns of run, trend, or cycle

III. RESULTS

Based on the sample statistics principles and the control chart concepts, the purposes of control charts is summarized as follows:

To provide information on the status of the production process in terms of variation existence.

To find possible assignable causes of variation according to the quality characteristic being investigated

To provide information regarding the quality of the product.

To monitor continuous process and conduct periodic review.

IV. USE OF A MICROCOMPUTER TO HANDLE VARIABLE CONTROL CHARTS

Advantages

- o A simple data entry method is used
- o There is no manual calculation and graphing needed
- o A data base is created after the initial data entry so it may be retrieved for future use
- o Control charts ($\bar{x}$-chart and R-chart) can be displayed on a VDT for quick review
- o It will provide a hardcopy printout for control charts (see figure 1), data record, and computation results

Major Functions

- o Methods of inputing data include: input of recorded data for a new job and continuation or retrieval of an earlier job for additional data input
- o Editing of Control Chart File
- o Graph of Control Chart: This function will graphically display the two control charts ($\bar{x}$-chart and R-chart)
- o Catalog of File names for easy reference

V. SUMMARY

After learning the concepts, calculation, and plotting procedures, case studies and/or practical problems handled by microcomputer and control chart software will provide students with a contemporary practice process quality control. Furthermore, learning efforts can be emphasized on the analysis, interpretation of the production phenomena instead of tedious, time-consuming manual operation.

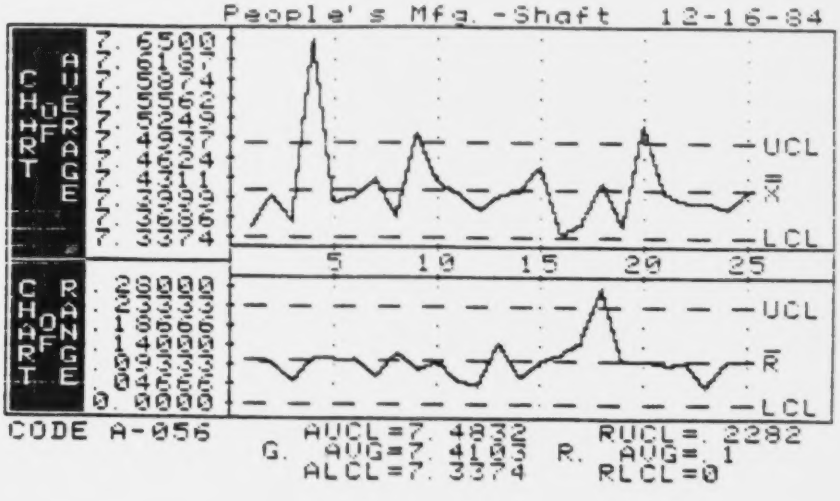

Figure 1: $\bar{x}$-R Chart Produced by Microcomputer Software.

Industrial Safety: Its Challenge In Industrial Technology

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ABSTRACT

The National Association of Industrial Technology requires that a single course in Industrial Safety be included in accredited curricula. the University of Lowell's Industrial Safety Course has faced many milestones in its development, but has achieved a level of interest, training and service which is unique. This evolution will be described in this presentation.

The concept of any single course within established curricula in itself is a challenge. What should be included? What must be excluded? What tests are available? Where do you go for information? What considerations have been ignored (or not recognized)?

Answers to these questions were found slowly - but they were found! It was decided early that the course would not be a simple regurgitation of safety legislation and standards; mere conformance to these is only the beginning of an effective safety program. Being active in the local American Society of Safety Engineers and joining the National Safety Council proved rewarding. Through these organizationa, information on what actual safety concerns are in industry and how they are changing were learned. This information was helpful in evaluating available text books; unfortunately, no single textbook was found which covers all topics selected. This problem persists, but students now utilize prepared notes which are the skeleton of a new text.

Another source of assistance was the Industrial Advisory Committee for the department; expression of industry's need for professionals, trained to communicate both orally and in writing, nucleated the idea of a term project which requires student involvement with local industry on safety matters. These projects not only train communication, but benefit local industry and expose all students to safety concerns unencumbered by the instructor's bias. Projects have even served as motivation for excellence in safety. Ms. Shah's presentation, A Hospital Application of Ergonomics, represents the 1986 Spring Semester Term Project judged best by a group of five educators and certified safety professionals. The project defines the role of ergonomics in comprehensive safety programs and describes how spills occurring in a hospital chemistry lab were significantly reduced and how operator comfort was significantly increased by ergonomic redesign of the process layout.

There is, of course, insufficient time in the classroom to cover all safety issues of concern. At present, a small group of student volunteers are participating in a discussion group which meets once a week to discuss potential breakthrough techniques in safety; participation is in lieu of the industrial term project. Topics being researched currently include self awareness in safety, alcohol and drug studies, video applications and interfacing between safety and other programs such as EAP programs. This experimental group has already demonstrated merit to the field.

The syllabus which has evolved for the classroom includes the following safety topics:

Introduction
Accident Causation
Systems Safety
Safety Management
Behavioral Science
Effective Hazard Control
Technical Issues in Safety
Material Handling
Slips, Trips, and Falls
Machinery Safeguarding
Fire Prevention and Protection
Industrial Hygiene
Student Presentations (Project or Discussion Group Topics)

Technical Art for Industry

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ABSTRACT

Communication by use of pictures has been a part of man's ways of conveying one person's ideas and thoughts to another since the earliest cave dwellers. Oral communication was probably by grunts, moans, and other sounds, but when they wished to record an idea, they drew pictures on cave walls, stones and other types of surfaces at their disposal.

Until the 1930's, overall, drawings were categorized into two major types: artistic and technical. Artistic drawings are those that graphically express aesthetic, philosophic, or other abstract ideas. Technical drawings are used primarily to represent a design of an object to be built; or a drawing of an object that has been built.

However, during the 1930's industry introduced another type of drawing to the arena of graphic expressions and conveying man's ideas and thoughts; it is called Technical Illustration. Technical illustration is generally three-dimensional drawings of two-dimensional technical drawings. These drawings closely match blueprint specifications. A good working knowledge of the various methods of pictorial (3-D) projection of objects is vital to the one who draws technical illustrations.

During the infancy of technical illustration, a new type of art began to emerge: Technical Art. Industry again was the creator of this type of graphic expression. Technical art in general, is a realistic rendering in black and white or full color of a technically drawn object.

Technical art had its real beginning in the automobile industry. During the forties and fifties, as industrialists began to develop new ideas about public relations, product research, design, and the importance of institutional and public advertising, so did the need for technical art.

Since its meger beginning, technical art has grown into an area of vast importance to industry. Industry today, regardless of size, uses the services of the technical artist in functions of organization, manufacturing and the marketing of its product and, in some instances, the technical artist does everything that is needed in the way of artwork. Consequently, the technical artist, in some situations, needs to be diverse in knowledge and use of proper equipment, tools, and materials. Daily workload can require the technical artist to do technical illustration, calligraphy, charts and graphs, posters, presentation art, and other types of art that are needed by the particular employer.

There are no known statistics available, but in general, the technical artist who works for industry does comparatively better than the counterpart. Industry offers greater job security, good working conditions, fair pay with provisions for merit raises, fringe benefits such as company paid group health insurance, group retirement plans, and liberal holidays and vacations.

Most technical artists are considered professional employees. They do not belong to labor unions, but they always share in the benefits that are gained by the union's negotiations and new contracts. Pay scales for technical artists are generally good: they differ, however, according to region, the type of industry, and the required work, and the artist's skills and experience.

The technical artist has, increasingly, been brought into industry as a solution to the broad variety of special and technical problems. By use of the universal language of pictures and symbols, the technical artist stands in the gap as an interpreter and communicator between those diverse groups in industry and those of society.

Improving on Work Standards in Construction

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ABSTRACT

Productivity, work improvement and engineering productivity are terms currently exchanged among professionals in construction. The basis for these terms was initially established by the work of Frank Gilbreth, Daniel Hauer and Frederick Taylor around the late 1800's and early 1900's. Specifically related to construction, Gilbreth implemented improvements which increased masonry output while Hauer addressed the concept of "Scientific Management". Aspects of his work on scientific management in construction included preplanning, crew balance and worker motivation.

Though theories of worker improvement in construction were initiated at that time, interest subsided until the 1950's when Henry Parker and Clarkson Oglesby again pursued the topic and formulated additional ideas. They examined concepts of preplanning, work sampling, time-lapse photography, and also human factors in their 1972 book Methods Improvement for Construction Managers. Since the early 1980's there has been increased interest and research associated with work improvement including implementation of work incentives, analysis of various measuring techniques, and studies on worker participation.

Hauer, in his book Modern Management Applied to Construction (1918), attributed a lack of acceptance of scientific management techniques in the field to an industry mind-set that "my work is different". Some contemporary writers on the subject of work improvement are challenging many of the traditional restraints thought to exist. These include characteristics such as uniqueness of the product, completion time of the project, size of individual projects, and the mobility of individual construction workers. These factors have commonly forestalled the implementation of new ideas for optimal usage of information, people, processes, methods and materials. Is the primary goal only to bring the project in on time and within budget or can more be desired beyond the end result? To accomplish additional goals the need exists to explore work improvement techniques.

Some work improvement techniques being considered are:

A. time-lapse photography
B. work sampling
C. questioning methods
D. foreman effectiveness checklist
E. craftsman questionnaire survey
F. foreman delay survey

Time-lapse photography involves a photographic record of conditions and activities found existent on the job site. Features include a condensed outlook of activities, an objective recording, immediate feedback, and an opportunity for managers and workers alike to analyze and evaluate job site activities and conditions.

Work sampling is a statistically based technique of randomly observing activities of workers and/or equipment. Large numbers of samples are taken at specific times and conclusions are drawn in regard to total work activity according to predefined categories of activities.

The questioning method (Critical Analysis) deals with a systematic analysis of primary and secondary questions regarding the necessity and sequence of activities. Through a series of exhaustive questioning and criticism the need for specific activities is determined and alternatives are examined.

The foreman effectiveness checklist is a questionnaire style instrument completed by the foreman, his supervisor and crew. The checklist evaluates the foreman's ability to communicate, motivate workers, plan and manage. It also looks at his interpersonal competence.

The craftsman questionnaire survey utilizes randomized sampling of workers from individual trades. Specific conditions and problems inherent on the job site are identified.

A foreman delay survey involves identification by the foreman of problematic conditions on the job site. It concentrates on problems causing delay as well as time lost and its effect.

A Partnership Between Industry and the University

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ABSTRACT

The Manufacturing industry in America today is in a state of rapid change which is leading toward automation. This situation presents both opportunities as well as problems for our present industrial technology programs in our colleges and universities. Some of our problems include acquisition of up-to-date equipment, faculty who need training and updating in areas of emerging technologies and new curriculum development. The opportunities are just as numerous. The challenge of a new curriculum, the excitement of learning new technologies and the discovery of new sources of funding to purchase state of the art equipment.

For the past two years, Industrial and Engineering Technology faculty at Western Kentucky University have been actively involved in developing a mutually beneficial relationship among the industrial community, the university and state government. This relationship developed out of a need to update the undergraduate manufacturing technology curriculum, a need for new equipment for instruction, updating faculty expertise and increasing student enrollment in the department.

The first phase of meeting our new challenge was to obtain input from the departmental industrial advisory committee, and make a statewide survey of industry. We then made a follow-up study of our graduates, visited institutions with highly visible programs, reviewed current literature and attended various conferences. Once information was assimulated and discussed, a five-year plan was developed. First priority items included revising the curriculum to meet the technological needs of industry, develop faculty expertise and increase student enrollment. Capital outlay needs were spread over the five-year period.

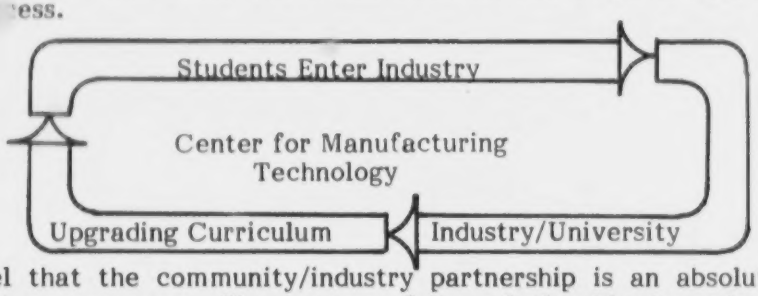
The most challenging goal of the entire project was to obtain state-of-the-art equipment considered essential for success. Like other institutions, Western utilizes capital outlay funds for matching purposes only. Initially 17 grant proposals were written to local, state and national agencies with no success. Finally, Span Tech and Johnson Electric, industries located in Glasgow, Kentucky, donated a conveyor system with four loading/unloading stations operated by a programmable logic controller. This gift was used in conjunction with a grant request to the Kentucky Commerce Department, Bluegrass State Skills Corporation (BSSC). The purpose of the grant request was to offer an advanced level training program to regional industry to upgrade the competencies of supervisors and managers. The BSSC granted an award to Western in the amount of $47,500. The grant enabled Western to offer 17 advanced level training workshops for 234 individuals and a total of 4,205 hours of instruction.

As faculty worked with regional industry through the training programs, a special relationship developed. Regional industry and the faculty soon realized that significant accomplishments could be achieved when both parties worked together. In broad terms, capacity had been increased at both the university and industrial settings. Furthermore, the partnership contributed to sustained growth, and the overall economic development of the community.

In eight months the department has been able to implement its five-year program complete with new equipment. Local industry has contributed over 500,000 dollars worth of equipment with the institution contributing $200,000. The department has the respect of the industrial community and is serving the needs of local industry by offering educational courses/workshops, providing support services and research expertise. In addition, a spring conference was presented at Western Kentucky University as a cooperative effort among the university, the Bluegrass State Skills Corporation of Kentucky, and the Southcentral Kentucky Chapter of the American Production Inventory Control Society (APICS). The conference was a huge success which further developed a solid relationship among the university, industry and government. Local industry is currently utilizing technical testing equipment at the university and drawing on faculty expertise. Industrial and Engineering Technology faculty are writing the guidelines for the establishment of a Center for Manufacturing Technology. The mission of the center will be to meet the research, service and training needs of regional industry. This approach will contribute to economic development by supporting existing industry and attracting new industry to the region.

The Center for Manufacturing Technology will have a positive impact on the undergraduate manufacturing program at the university. The center will help keep faculty abreast of the latest changes in technology which will ultimately be integrated into the undergraduate program. Therefore, program graduates will be on the cutting edge of manufacturing technology and highly desirable to industry.

This creates a cycle as follows: 1) graduates enter industry; 2) industry and university work together to advance manufacturing technology; and 3) the university then utilizes the results of the joint effort in advanced technology to upgrade their curriculum. This cycle which has been formed helps to insure a dynamic learning process.



Faculty feel that the community/industry partnership is an absolute must for technology type programs. The success of the relationship depends on effective communications, responsiveness of the institution, flexibility of industrial training programs and a commitment of both the faculty and supervisory staff in local industry.

Through this process industrial and engineering technology faculty have completely revised the undergraduate program, have developed a close working relationship with industry and have improved the image of the program. In addition a 22 station Auto Cad Laboratory with two Cal Comp plotters, a flexible manufacturing cell with conveyor, NC vertical milling machine with automatic tool change and a GMF M1 robot, obtained with funds secured with an NSF grant, have been installed. An industrial grade Kingsbury machining center has been donated by Holley Carburetor of Bowling Green to support instruction. Video facilities including a large screen television and a VHS recorder have been purchased to bring industry into the classroom to support instruction.

New Material Trends in Construction

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ABSTRACT

INTORDUCTION

This paper focuses on one, the historical evolution of construction materials particularily fiber-reinforcement, two the development of the various materials used in construction and three the applications and future uses of composite reinforcing materials in the construction industry.

HISTORICAL REVIEW

Continuous development and improvement of construction materials has been and still is one of the most important facets in human life. Since the dawn of civilization new materials for residential construction have enjoyed a great deal of researching and improvements. Noted among the efforts to find strong and adequate materials for construction are the use of composite materials. Random (as well as prefrentially orientated) fibers are frequently used to improve the behavior and strength of construction materials under loads. Natural fibers such as straw, palm-tree, and coconut have been used in construction materials for thousands of years.

The technology of fiber-reinforced building materials can be traced back to antiquity, when straw was used to make bricks. This statement about fiber reinforcement comes form Exodus 5:7, "Ye shall no more give the people straw to make brick, as heretofore: let them go and gather straw for themselves." This technique is still used today in the American southwest utilizing adobe building materials. As a matter of fact, natural fibers are still used today in many third world countries, for example, straw in the middle east, palm-tree fibers in eastern Asia and the southern hemisphere in general.

Since the turn of this century construction fiber reinforcement has grown from plasters and mortars to new applications in soil stabilization and concrete. These reinforcing materials have changed from natural fibers and animal hair to include metal fibers, ceramics, polymers and even composite fibers which are coated or surface treated.

CONSTRUCTION REINFORCING FIBERS

This presentation focuses on the utilization of steel and polypropylene fibers in construction since they are the two main secondary reinforcing materials in concrete. Steel fibers have been added to concrete since the early 1920's. Polypropylene fiber reinforcement has been used since the mid 1960's, but has not reached wide use and application until this decade.

REVIEW, FINDINGS AND RESEARCH EVALUATION OF THE MATERIALS

A review of the published research, plus the results of research c onducted by the presentors will be discussed in this presentation. These results will include test results according to ASTM 4.02 C-39 compression cylinder testing, ASTM 4.02 C-78 flexural testing and ASTM 4.02 C-496 splitting tensile. The effects of fiber additions to concrete as well as the effect of chemical treatment of the fiber surfaces and concrete matrix on the above mentioned properties are presented. In addition, the statistical analysis of the results and the ultra-fine microstructural analysis utilizing the scanning electron microscope will be reviewed as well.

CONCLUSIONS

The trends and uses of new fiber reinforcement in concrete will continue to grow. Efforts are being made to overcome the draw backs of secondary fiber reinforcement in concrete. As standards are developed through research and emperical evidence, fiber reinforcement in concrete will aquire more importance and use in the construction industry.

Industrial Technology programs should take the lead in this area to develop, research and teach the associated technologies within this area through the already existing construction technology curricula.

Non-Destructive Evaluation of Industrial Products

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ABSTRACT

Non-Destructive Evaluation (NDE) techniques of industrial components and products, commonly known as Non-Destructive Testing (NDT) of materials has become a very important tool in industry for a number of years now. The international competition for world markets for many industrial products dictates that the product should be reliable and almost flaw-free. Many new ideas have recently received more attention in the production and manufacturing industries in light of the severe world-wide competion. Such areas as Statistical Process Control (SPC), Total Quality Concepts (TQC), and NDE are being introduced, researched, taught and implemented in many industrial as well as educational settings. Testing to insure product soundness and safety could mean testing every single component off the production line. Obviously this could be very expensive and not feasible. Subsequently a representative sample is chosen from the population of the produced component according to established statistical norms and tested by the quality control personnel in the establishment before final approval of distribution of the batch for use. For mass-produced components, it is apparent that such statistically chosen sample is not enough to insure the integrity and safe use of all manufactured components. Increasing the number of components to be tested in the conventional manner is costly and difficult if not impossible in some cases with the present testing methods. Non-Destructive Testing, however, proved to be of great potential especially with the fast progress in the technology associated with the testing methods used. If there is a way to test ALL components off the production line, this will only be through NDE.

Some commonly used non-destructive tests in industry today are radiological tests (x-rays, gama-radiation...), magnetic particle tests, ultrasonic tests, eddy current tests and fluid penetrant tests.

In radiography tests the flaws present in any component are revealed due to the different elements selective radiation absorption criteria. The internal features of the manufactured component are hence mapped, recorded and evaluated. According to the findings, a diagnosis of the problem and hence elimination of it becomes possible.

Magnetic particle tests are used to check for surface and near sub-surface flaws in magnetic components through the mapping of piled up magnetite (Fe_3O_4) powders at the flaw sites due to magnetic flux leakage phenomenon.

Ultrasonic tests utilize high frequency sonic waves to detect internal (as well as surface) flaws. The ultrasonic waves use the component as a carrier medium for its transportation. Detection of irregularities in the wave's travel path usually indicate a flaw site and is easily monitored on CRT's or with special indicators.

Disturbance of electrical flux generated by eddy currents through a material due to local flaws, impurities or discontinuities could also be detected and traced to a source or cause that can be ratified to prevent its occurance in future components.

The fluid penetrant test checks for surface and subsurface flaws with openings to the surface (e.g. cracks and porosity...etc.) through the use of a fluid with very low viscosity to fill such cavities and then developed later by using special powders to indicate its location.

A combination of fluorescent powders and black light (ultra violet radiation) are commonly used to enhance the detection of surface flaws in such techniques as the pentrant test and the magnetic powder tests.

Technology programs in general, should introduce the students to the importance of Non-Destructive Evaluation of Material. The following technology programs, however, should at least include one course in their curricula in NDE: manufacturing and production, industry, foundry, energy and power (electronics), aerospace, mechanical engineering, and construction.

AUTOMATIC IDENTIFICATION - The Big Picture

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ABSTRACT

The need for fast, accurate, and reliable information has forced industry to search for alternatives to manual notation and keyboard entry of data. In order to automate and eliminate slow and error-prone data entry methods, industry has begun automatically identifying parts, products, people and paperwork. This automation of data entry is called "Automatic Identification".

PRODUCTIVE USES OF AUTO ID

Automatic identification, or auto ID, is being used to increase productivity in manufacturing, health care, warehousing, and distribution. Quality control inspectors, using voice recognition technology, routinely enter data into the computer even though their hands are busy manipulating silicon chips and microscopes. Tool room employees can identify the contents of closed, shelved containers using surface acoustic wave technology. Overnight parcel delivery companies can know the real time location of any of thousands of parcels using a bar code system. Hospital patients and prescriptions can be matched and double checked without a nurse ever touching a keyboard or chart. Even the U. S. Patent Office uses automatic identification to track the flow of documents.

AUTO ID TECHNOLOGIES

There are seven major auto ID technologies. Each has unique characteristics that make it most useful in particular applications. There is no one "best" auto ID method.

Bar Coding

Bar codes are everywhere; they are found on credit cards, packaged foods, and automobile repair parts. In the 70's, the supermarket industry established the Universal Product Code (UPC) standards and the bar code era began. Beginning in 1986 the vehicle identification number (VIN) of all motor vehicles will be encoded on the vehicle in Code 39. The vehicle can be tracked through assembly, to the dealer, and even on to the "junkyard".

A bar code is a visual representation of the binary code, ones and zeros used in the accessing of computerized information or data. A bar code is a series of dark bars and light spaces which are used to represent letters and numbers. The specific arrangement of these bars and how they are interpreted represents the symbology of the code. Several different codes are available for use. Scanners are used to pass light over the bar code and measuare the reflected light. Differences in intensities of the measured light creates the signal which

is interpreted and sent to the computer. Data from the bar code is then accessed by software in the computer and used in a variety of ways.

Optical Character Recognition

One of the older technologies still in use is optical character recognition, more commonly referred to as OCR. It is based on pattern recognition, wherein a reflected light pattern is matched with patterns in memory. OCR is used in retail applications; price tags, inventory information, etc. OCR is also widely used in documents processing, for example reading electric utility bills or bank checks.

Magnetic Stripe

The magnetic stripe on an employee's plastic badge can contain all the pertinent information needed to clock in or out, gain access to restricted areas, or record time on task. Most people are familiar with the mag stripe identification on their bank or charge cards.

Radio Frequency

This method of auto ID requires a low powered radio transceiver and a transponder for each device to be identified. The location of each vehicle on a construction site can be tracked automatically in real time using RF technology.

Surface Acoustic Wave

Closely related to RF is Surface Acoustic Wave (SAW). A transceiver emits a signal which is reflected from a special tag back to the transceiver. Each tag is coded uniquely, thus allowing differentiation of various parts or objects. The feed ration for dairy cattle can be automatically adjusted to accomodate unique requirements by tagging each cow with a SAW tag.

Voice Recognition

Pattern recognition is again used in this technology to match voice patterns with those recorded in memory. Voice recognition is useful for entering data when both hands are already in use; sorting mail bags or manipulating devices.

Machine Vision

Machine vision, still another use of pattern recognition, is in the infant stages for use in auto ID. It holds great promice for identifying part-in-process for computer integrated manufacturing applications. A camera is used to obtain a picture of an object to be identified. The shape or configuration of the object is compared to those stored in memory. Based on the match, the computer can give specific directions to the machinery.

FMS Effect on IT Core Courses

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ABSTRACT

Flexible manufacturing systems (FMS) are defined along with their development, scope, and attributes as they serve industry today at the leading edge of manufacturing technology. Most curriculums have been following this field and providing the information to students in recently added courses titled, Numerical Control (NC), Robotics, Computer Aided Manufacturing (CAM), and Computer Integrated Manufacturing Systems (CIMS). The time has come to move the dissemination of basic concepts and application into the core courses where they will enhance and sometimes replace presently taught concepts and material.

This presentation analyzes each of the three major components of a flexible manufacturing system - numerical control operating stations, computerized material handling system and the computerized control system. The advantages of each component is developed and related to course content in the industrial technology core curriculum.

Numerical control operating stations (NCOS) provide for increased machine utilization by minimizing setup time, efficient workpart handling, and simultaneous workpart processing. These are topics of Motion & Time Study and Manufacturing Processes & Tooling. They reduce direct labor and its per unit cost, a concern of Cost Control, Analysis, & Evaluation. Multi-axis NCOS reduce the workpart setup, fixtures to support the operation, and quality variations due to less workpiece setups and refixturing - topics of Manufacturing Processes & Tooling, Motion & Time Study, and Quality Control & Reliability.

Computerized material handling system (CMHS) reduces indirect labor by using unmanned material handling devices delivering and retrieving components and tooling in a quicker and more accurate manner with total tracability. They are part of a closed-loop automatic storage and retrieval system servicing both parts flow and tool setup. These are topics of improvement in Facilities Planning & Materials Handling, Production & Inventory Control, Manufacturing Processes & Tooling, and Cost Control, Analysis, & Evaluation. Lower in-process inventory is a result of reduced process time, reduced handling time, and continuous control material handling and storage - topics for Production & Inventory Control and Cost Control, Analysis, & Evaluation.

The computerized control system (CCS) provides for increased machine utilization and reduced labor through adaptive control of the process. Both its design and functional results are topics for

Computers & Systems Analysis, Manufacturing Processes & Tooling, and Quality Control & Reliability. Scheduling flexibility is greatly enhanced by the formerly unrealized super-speed of information processing of large data bases of storage and real-time operating information providing topics for Computer & Systems Analysis and Production & Inventory Control.

Unfortunately, the simplicity of the FMS concept masks its difficulty of execution even though it appears to be the answer for which industry has been searching. Costs of FMS have been almost prohibitive during the decade of the 1970s even though they yield high savings. Technological improvements and increased volume use of components in the computer field help alleviate the cost factor providing example material for Cost Control, Analysis, & Evaluation and Computers & Systems Analysis. Difficulties of work station loading and balancing within the individual system require new thinking and approaches by production scheduling to maintain highest productivity for each work center within the FMS - new approaches for Production & Inventory Control.

Some of the effects of flexible manufacturing systems on industrial technology core courses are summarized as follows:

1. Facilities Planning & Material Handling will see a trend away from the job shop process layout, toward the group technology derived computer-integrated manufacturing systems, focusing on FMS. This leads to the "core" concept of facilities layout.
2. Quality Control & Reliability will see less emphasis on incoming sampling plans as responsibility for quality is pushed back to the supplier's process control. Quality process control will be taught for use and application through machine-computer instantaneous feedback control.
3. Manufacturing Processes & Tooling will shift emphasis to multi-axis, multi-process equipment with tooling, fixturing, and processes that are lighter in weight, use less and waste less energy in accomplishing the task, and are more versatile in handling a variety of workparts. The shift from hardware fixturing to software fixturing will take place.
4. Production & Inventory Control will put more emphasis on reducing and eliminating in-process, safety, and buffer inventory stock. Instruction will concentrate on the development of computer controlled operating systems using an operation wide data base.
5. Computer & Systems Analysis will detail the basics for developing economic speed, accuracy, and resolution through present and future hardware and software developments.
6. Motion & Time Study will move its concentration from the analysis and development of better physical work methods, standards, and incentives to better mental work and control methods, standards, and incentives.
7. Cost Control, Analysis, & Evaluation will shift its emphasis from after-the-fact direct labor analysis, control, and evaluation to real-time new techniques of indirect costs analysis, control, and evaluation.

SOLAR ENERGY RESEARCH AT ISU

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ABSTRACT

During the past eight years, our work in solar energy has been centered around various strategies for summer space conditioning or cooling. This direction was taken because of a recognized need. Researchers had almost completely avoided this area while expending heroic efforts on solar or low energy heating. In 1977 we hardly knew the meaning of 'passive solar'. Passive solar was so new and so simple in concept that the Federal Government would not acknowledge that it existed, let alone promote or fund research. However, researchers did it anyway, focusing their efforts entirely on heating. A few individuals began to promote the idea of a 'total living environment' and quality of life which involved annual strategies for space conditioning, including daylighting. Although this was impressive to many, I was more more impressed by the way we were suffering through much of the humid midwest summers.

In 1978 we began research on a little known dehumidification/cooling method involving the use of liquid desiccants such as triethylene glycol. This scheme works well, but has disadvantages that we could not to put up with; disadvantages that are inherent in the technology. The next phase involved dehumidification using solid desiccants such as silica gel. This scheme was quite successful and is ideal for marriage with an air type active solar heating system. But the active systems, being much less desirable than passive solar automatically reduced the desirability of desiccant dehumidification. using a dehumidifier that we developed, we were able to bring air down to 6.2% relative humidity. We also began working with earth cooling tubes, installing some of our own and simply monitoring others. This strategy involves blowing either recirculated or ambient air through underground ducts that are intended to cool and dehumidify the air. This idea will work if you are in an area where the annual mean temperature is no higher than about 60 - 65F. However, it is not a powerful technology; there are several disadvantages including high cost and relatively low performance. There are few advantages.

In 1981, at the annual American Solar Energy Society conference in Philadelphia I heard two scientists from Argonne National Laboratory present a paper on using naturally formed ice for summer space conditioning. Because of it's temperature and the amount of energy contained in ice (144 BTU's/lb), it is in fact a very powerful mwdium for low energy cooling. The following week I was invited to attend a small, closed ice workshop at ANL. There I met five leading experts on using ice for cooling including Ted Taylor from

Princeton, Cal MacCracken of Calmac Corporation, and Tony Gorski from ANL. After the workshop I got together with MacCracken and Gorski to talk about a project, then wrote a proposal using an idea of MacCracken's and some suggestions by Gorski. The Illinois Department of Energy and Natural Resources funded the project and in 1983 we were in full operation. During the winter of 1983-84 we made approximately 65 tons of ice using the natural coldness of winter as the main energy input. The following summer, 740 ton-hours of cooling were extracted from the stored ice. With recent modifications, system COP has been increased to approximately 12. It has been an exciting project with results and success exceeding original expectations. Over the past 18 months I have been working with Bob Tamblyn, a well known Canadian engineer, on a proposed system design for cooling a 100,000 square foot building with a load of 1 Ton/500 square foot. On paper, this scale appears to be quite feasible. The Chinese are looking at ice for large scale refrigeration and for air conditioning.

Our current solar energy project involves the design, construction, and testing of a 6 peak Kw line interactive photovoltaic generating system. This will be the largest PV system in the State of Illinois and will be located near Aurora. In operation, we will supply power to a park administration building and the excess power will be sold to Commonwealth Edison (electric company). We will have four separate systems demonstrating four different technologies including single crystal, poly crystal, ribbon and amorphous PV cells. Each system has it's own synchronous inverter and will convert 48VDC to 120-240V 60Hz AC, line synchronized. The four system outputs will be combined through 15 A double pole breakers and a 100 A main. A Daytronic data logger/controller will collect and store data and will display real-time data on a 25" color monitor and approximately once each week data will be dumped to the VAX via telephone link. System limits can be programmed so that malfunctions or problems will initiate via telephone, a call for help while giving us a report of what's wrong. The systems should be fully operational sometime this winter.

Mobile Computers: Their Uses In The Educational Setting

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ABSTRACT

The utilization of computers is the educational setting is well underway but their applications are limited to a rather narrow scope. The majority of computers in use in school systems today recieve their data from a source that can be traced back to a keyboard and the processed data is used to fill a CRT or a printed page. Even the computer controled machines are largely keyboard input.

A world of applications are comming into being which recieve their input directly from their real world environment and use this data to react with that environment. One area which utilizes this concept is personal robots.

The idea of a personal robot may seem a little avant-garde but so was the idea of personal computers only a decade ago. The workplace is moving toward more automatic and intelligent machines to meet the manufacturing needs of our society. Personal robots represent a world of computer applications which our graduates will profit from the experience of working with.

Their are several personal robots on the market today that can assist the technology instructor in developing a foundation for their students. They range in price from several hundred to several thousands of dollars. The main differencies between the systems is not necessarily what they are capable of doing but rather the sophistication with which they do it.

SAMPLE SYSTEMS

The HOBBYBOT, marketed by Rio Grande Robotics of New Mexico, is an inexpensive personal robot to introduce the fundamental concepts to the classroom. It is based on the same CPU as used in the Apples, and is programed using BASIC. With its low price and expandability it represents an excellent starting point to teach the fundamentals of personal robots. The HOBBYBOT is designed to be expanded allowing for the utilization of todays electronics technology. The ease of expansion allows middle and high school students to work with the chips and circuitry that are the mainstay of our technological world, and to work with this technology in an applications mode.

The RB5X, manufactured by GENERAL ROBOTICS of Colorado, is a mid-priced system. The RB5X has a laboratory trainer with built in circuitry which allows it to measure its physical environment charateristics (heat, light, sound and distance). These real world inputs can be used to activate and control the robots drive wheels, voice and 5-axis arm. It can serve as an ideal system to teach the fundamentals of personal robotics not only from an applications standpoint but also at a hardware/software interaction level. The RB5X can be operated with BASIC as well as several other RCLs (robot control languages). Its radio frequency link allows for remote control of the system as well as an opportunity for students to study the electronics of radio frequency data transfer systems and computer bus structures.

The PL 100 SYSTEM, manufactured by ELEXOR of New Jersey, is not a personal robot but it is the foundation for building your own system. The battery operated system is programable using the Radio Shack Model 100 computer. The PL 100 has analog inputs and outputs, digital (TTL) inputs and outputs and analog comparitor circuits. The system operates on BASIC and represents an excellent opportunity for a low cost measurement and control computer.

The personal robots are just comming into their own. It is time that we assist our students in this relatively new field which combines mechanical and electrical systems in a mobile, interactive environment.

Configuring A Data Acquisition, Control And Networking System For Factory Automation

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ABSTRACT

Advances in microcomputer technology have made personal computers (PC) a very attractive solution for many industrial data acquisition and control applications. Traditionally, special purpose minicomputers costing $20,000 to $50,000 have been used in laboratory data acquisition and controlling manufacturing processes. Now, a broad range of less expensive solutions are available that use an IBM PC or compatible with plug-in boards that permits a data acquisition and control system to be configured for less than $10,000. With the emergence of the IBM AT, which removes the limitations of speed and addressable memory, a flourishing market of hardware and software manufacturers has matured around the IBM standard. This presentation will describe the various types of data acquisition hardware and software available, as well as the benefits and drawbacks. In addition, some networking capabilities for distributive control will be examined.

There exists a wide choice of both hardware and software for data acquisition and control application solutions. There are three basic configurations that are categorized by the location of the analog-to-digital conversion and related circuitry, and the method of interfacing to the PC. The most common and least expensive configuration is the add-on board that fits in an expansion slot in the PC. The add-on board usually comes with a ribbon cable that connects an external terminal panel which is used for attaching input signals. The chief advantages of this configuration are the direct connection to the PC's bus, which allows very fast reading rates and their low cost. Data Translation, Metrabyte and Opto 22 are among the leading hardware sources. The maximum number of inputs to any design is limited to channels on a particular card and the number of available slots in the PC.

A second approach is to move the data acquisition functions to an external box called a front end. This approach uses a bus extension scheme for communication and requires that the front-end and PC be located near each other. The advantage in using this approach is the isolation of electrical computer noise from sensitive low level input signals. Also, the bus extension approach increases the number of slots which offers greater flexibility in configuring complex systems. However, the extension approach still limits the number of input channels since all channels get access to the PC using direct memory access on the same interrupt level. Another limitation is that the external box must still be located near the host PC. If the bus extender approach solves an application problem, both Cyborg and Cyber Research provide a bus extender box.

The third approach is to put more computer functions in the external box or front end. This front end will include having its own controller, memory buffer and communication interface through a serial connection to a PC. Such an intelligent subsystem can connect to any type of PC at almost any distance. It is used where data acquisition and control is located at a remote distance from the PC. The front end is more specialized to withstand the harsh industrial environments and permits the host PC to be remotely located in a less harsh environment. Opto 22 provides an interesting product line for implementing this approach. Data Translation, Action Instruments, and Datem Limited also provide front-end boards configured in a multidrop network scheme.

Choosing the correct add-on board for data acquisition is a process of identifying the specific application needs. How many points need to be monitored or controlled? What type of data is required? How is the data going to be used? What are the physical requirements? What is the level of isolation, resolution, and throughput desired?

In the area of software, all add-on boards manufacturers provide some level of software support. However, third-party software that supports multiple boards are available. When evaluating the software, examine three factors: how well the package performs the I/O functions, whether it can handle both data acquisition and control or just data acquisition, and what analysis and display capabilities exist. Labtech Notebook supports the largest number of boards and has two analytical routines--nonlinear curve fiting routine and Fast Fourier Transforms (FFT). It takes advantage of an 8087 math coprocessor to perform the routines. To perform additional analysis or any graphic display, one must purchase a spreadsheet program such as Lotus 1-2-3. However, Lotus 1-2-3 is not optimized for engineering analysis. A spreadsheet for engineering analysis is RS/1 from BBN Software Products Corporation. Labtech Notebook also provide process control modes, such as proportional-intergral-derivation (PID), on/off, and alarm.

In conclusion, there exists a variety of hardware and applications software which make the PC-based data acquisition and control system the best choice in certain situations. The general purpose nature of the PC and enhanced power allows the user to tailor a data acquisition system to meet specific requirements. The trend is for increasing acceptance of the PC in the industrial environment.

(GEN)

Strategies for Change: Development of New and Emerging Technology Programs

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ABSTRACT

Whether we realize it or not this nation is presently engaged in a second industrial revolution. The changes needed for our industries to survive against international competition are directly related to improved production, plant efficiency, and product reliability. Programs in Industrial Technology have an obligation to aid in the development of qualified professionals needed for factories of the future. While some would view this as a difficult challenge, others would view this as a golden opportunity for exciting changes to take place in our curriculum and facilities.

Before new program directions can occur, it must be determined what needs must be met. It is vital that past research studies be reviewed and in some cases new studies be completed to establish programmatic need. It would be important to involve an industrial jury to give focus to the research instrument. One way to begin is to involve Industrial Technology advisory council members in the process along with other appropriate industry representatives. It is important that each program be noted for some degree of specialization in the field of Industrial Technology. This becomes an important marketing tool to attract students and industry.

Once program direction has been identified, it is vital to win the support of the upper administration. The Industrial Technology Department must involve deans, vice presidents, and the president in its development process. One of the best ways to get administrators familiar with the need is to invite them to visit select high tech industries to observe operations first-hand. Of course, such visits do require preplanning with industry executives to ensure maximum impact. It is absolutely imperative that internal campus relations be on a sound footing before attempting to expand external resources.

Once the need has been established within the university, then a long range plan must be developed involving faculty, program, and facility development. Do not expect to complete a plan in less than five years. Faculty trained in the appropriate technologies should be of the highest priority. This can be done through summer hires in industry, sabbatical leaves and short term workshops. Program development should be coordinated with faculty development to

ensure use of the newly acquired knowledge as soon as possible. An effective leader must plan carefully and demonstrate how each faculty can benefit from the new and exciting challenges ahead. It is important to reward those who contribute to the change process and accept their obligation to be retrained. Facility changes are usually two years down the road and must be based on program needs. Minor renovations are much easier to accomplish than major additions. The only solution where very outdated structures are involved may be a new addition while could take upwards of 10 years to justify and complete.

Meeting new technology demands will require rather large sums of money, maybe as high as one million dollars. Several avenues can be used to raise the appropriate revenue and equipment. The program plan will require the identification of equipment needed and its cost. A spread sheet should be developed with equipment prioritized. This program proposal can be used to (1) sell the administration on need and (2) present your case to selected interested industries. Matching funds make most administrators very pleased and thus tend to insure repeat allocations. One danger is, however, that your program does not need as much assistance since industry is willing to provide support. Other means of gaining financial support are alumni donations, industry sponsored annual banquets, grants, and discretionary contributions to the University.

Department Chairs must be very effective in public relations and program marketing techniques. Strong programs have sound student enrollment and continued recognition by industry. In some cases, it may be necessary to team up with other disciplines on campus to gain maximum administrative support for program development (i.e. computer science, business, engineering). The key to industry or other on-campus involvement will be to demonstrate how each will benefit, often referred to as a "win-win" situation.

In summary, development of a new program calls for very careful planning, internal campus relations, faculty development, program development, facility development, funding, and industry support. Funding sources are limited only by imagination and initiative. If Industrial Technology Programs are to survive and prosper in the future, then there is only one realistic choice, "Go For It".

Technological Education and National Development in Zimbabwe

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ABSTRACT

Six years ago Zimbabwe became a nation following 75 years of white rule and thirteen years of unilaterally declared independence (UDI) as Rhodesia. UDI provoked international sanctions and boycotts which severely limited external trade except with South Africa. The sanctions heightened the Rhodesian need to be self-sufficient and to show that they could be as "modern" as the rest of the world. The result of these efforts was that Zimbabwe inherited a sound technological infrastructure based on agricultural production and mining. While a few blacks were educated or trained in technological or industrial fields, the overwhelming majority of those who received formal training or were in supervisory or management positions were white. A large majority of those whites left the country when Zimbabwe came into being. Thus at Independence Zimbabwe was faced with a solid technological infrastructure and training system but had few citizens qualified and available to maintain the systems.

The immediate need of the new country was for instructors for the technical institutions and secondarily for curriculum and test revision. The basic academic schooling also needed to be expanded and made more practically and technologically oriented so that school dropouts and graduates are better prepared to find employment or to continue training in the industrial, technical and agricultural sectors. In the post-secondary technical colleges, the first level of technical education, the curriculum needed to be made more competency-based. Most blacks working in industry were very experienced but were not certified because certification only came through formal training. They were thus both underpaid and unable to hold positions commensurate with their skills. In addition the technical college curriculum needed to be shifted from a U.K. orientation (London City and Guilds Examinations) to one focused on African and Zimbabwean needs and realities.

The ZIMSCI Project was the first step towards strengthening technical education. The Project developed basic science kits and provided teacher training at all levels of the school system with the aim of improving the students' background in the sciences and scientific thinking. The second step was to train new teachers and retrain older ones at both the elementary and secondary levels in a major and a minor speciality in technical/industrial/crafts/agricultural orientation, skill and pedagogy. Meanwhile revision of the curriculum was being planned to incorporate a practical, applied, skills oriented approach to what had been a purely academic stream. As a part of this revision a curriculum and teacher training team visited the United States in 1984 to look at pre-collegiate vocational education, a new concept to them. They were especially interested in seeing how the training was integrated in the students' schedules and how training received related to what graduates did after high school.

To meet the post-secondary technical institutes needs, teacher/curriculum developers for apprentice and technician level instruction were sought through agreements with the United States, Canada, Great Britian and a few other

countries. As part of a plan to expand technical training opportunities, international donors were sought to provide funds for building and equipping new technical institutes and for the training of technical teacher educators. Training centers were also created for upgrading certifications for those already employed and for retraining those who had spent many years engaged in guerrilla warfare. Because many had been moved into managerial and supervisory positions to fill vacancies created at Independence, a special training unit was established to provide short courses in relevant administrative skills.

The University of Zimbabwe has also suffered a shortage of staff, but have significant numbers in training. Some critical areas, especially in medical and engineering specialties, were in need of expatriat assistance. In addition to recruiting the staff for the University in engineering, the Government decided to establish a Bachelor of Technology program at the technical colleges to produce broadly grounded and practically oriented engineers. The program was developed with US expertise and initially staffed primarily by people recruited through a US Agency for International Development (A.I.D.) grant managed by the Academy for Educational Development.

As the urgent steps have been taken or processes set in motion the next level of needs are being planned for or met. The three most pressing needs are equipment and texts, a unified approved syllabus, and a responsive data base and planning process. Most technical libraries are very small and many students have to share one text book. Texts are being sought through purchase and donations -- over one and a half tons of books have been donated to Zimbabwe for technical education from one source in the US alone. Equipment is modern up to 1980 but parts are hard to come by and the new technical institutes are either woefully under equipped in some areas or not equipped in other areas. Work has begun to unify the syllabus for each technical subject taught, in part to be sure that students are being prepared properly for the national examinations and in part to be able to approve programs offered by private institutions in the business and craft areas.

Computers for management planning have been supplied through A.I.D. funding and plans drawn for a similarily funded computer linkage between the technical colleges and skill training centers. Together the systems will allow the Government to be on top of information about the number of people in training, expected graduation dates, staff qualifications and budgeting expenditures so that scarce resources can be properly allocated and needs planned for. These steps and others set in motion a national plan for the development of technological education on many fronts.

Foreign Manufacturers Are Causing Turmoil For American Buyers

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ABSTRACT

Through the strengths of cheap labor, the gift of American technology and good marketing techniques, foreign manufacturers are changing the old-line buyers to switch from American products only. Since the end of World War II, America's technology has been transmitted into our intent to rebuild our assault on foreign countries for our freedom. Foreign manufacturers' rebuilding and restructuring of economical plants and their work force were easier to develop than our future attempt at remodeling our own dated technology. Foreign manufacturers have not had to replace old equipment and archaic work styles.

Americans have rebuilt our industry from equipment that is a minimum of 35 years old--often leftovers from World War II. Our workers are not just new employees, needing training, but experienced workers that have to psychologically adjust to change before accepting new ideas.

Taiwan manufacturers, such as Heypee Industrial, have entered into competition with the American bolt market. By using computer-tape controlled equipment, newly-trained labor and American marketing techniques, Heypee has used, for example, the one-half inch wheel bolt used on the American automobile and recreational vehicle industries as their base in the market place. Heypee Industrial has manufactured and delivered to American locations the bolts at $0.081 per item in comparison to three top American manufacturers within 100 miles of their consumer who are charging at a range of $0.111 to $0.132 for each bolt.

In their efforts to keep foreign products out of the market, the American buyer has continually compared all vital statistics that relinquish any doubt as to his new attitude toward changing vendors. Quality control programs are easy to adapt for foreign products because they are not having to replace or rebuild anything but just start new and learn only new ways. Quality is assured by American standards for the national marketplace by the former "American-only" buyers.

Visiting foreign plants makes the observer aware that their technology is as good as--if not greater than--the American counterpart. In Taiwan, for instance, they used their neighbors, the Japanese, to computerize all production and design machines capable of speeds that American unionized production workers would not accept. That warrants high dedication by the workers supporting the production lines. The Taiwanese workers get one mid-day break during intensely warm weather but will put in ten to twelve daylight hours for one-third of the American salaries while their benefits are nil.

By combining technology with low-cost labor, we can graph the numbers to show why the foreign manufacturers are cutting 40 to 45 percent off of the American market. Attitudes are changing for the buyers, but we need to challenge the American manufacturers to a belief in reinvesting and rebuilding their base. Along with the change in management, the American worker must realize that with the old-style standards, International Harvester and Chrysler came close to folding.

American manufacturing and marketing systems will recover by rediscovering the issues. In regard to lifestyles and benefits, the foreign workers are still in the 1920's and 1930's as we knew it in the U.S.A. As they demand more and more, we will once again regain the great American leadership in manufacturing we once had accomplished.

Heypee Industrial is not the only company from foreign shores to accept the American challenge. Other companies include N.T.N. Bearing Company of America (Japanese), American-Koyo, Marsuda-Rodgers (Romanian and Yugoslavian) and S.K.F. (Swedish and Mexican). A day will come when the American buyer will not have the threat of these and other foreign manufacturers creating turmoil to the standard of "American only." For today, the American buyer must consider the challenge of foreign competition.

"Social Impact of Technological Change"

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ABSTRACT

Throughout the history of humankind we have been influenced by technological developments. Each development has been designed to make some human function easier, faster, safer, more convenient or some other noble purpose. In short, technology should make human existence better. Technology is progress. Technology is good. Yet many favorable effects have also been detrimental, harmful and even deadly (notwithstanding the military uses of technology).

This presentation centers around an examination of these favorable and detrimental effects of technology. Many of these effects have been documented by Toffler, Reich, and others. Even Connections has attempted to link technological development with major advances in the human condition. These authors and scholars tend to view technology as it has effected society as a whole, changing the basic tenants of our value systems.

This examination of changes to society is vital if we desire to remain in a reasonable homeostasis while technology moves ahead and effects more and more of everyday life. It is perhaps the only component that separates technology education from technical education.

Recent occurrences from the Soviet Union, to my own backyard of Toledo, Ohio reflect the hazards and concerns over energy production. The loss of market share to foreign competition, and loss of jobs to automation reflect concerns over manufacturing efforts. An explosion of instant communication changes the way we interact with others and creates an atmosphere of less frank, open discourse and more "carefully" prepared statements. Each of these technological developments and effects change a part of the way we react and interact within a world society. Technology is changing the way we think, act, react, interact, and value.

Perhaps most discouraging (or encouraging depending on your personal perspective) is the condition that technology does in fact govern thought. Not just thought on technical matters, but philosophical matters as well. What can be done, and how it can be done become more important than why

something is done. There seems to be a surprising lack of discussion, short of profit motives, as to why companies make decisions. Perhaps only profit matters to modern, technological, society. It is certainly a central theme while other more "lofty" purposes are secondary.

Technology has undeniably changed the way society functions and the way the people of that society think. How these changes are manifest in society and some implication for the future will be considered as well.

Basic Supervisory Training - Implications for Technologists

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ABSTRACT

The idea for this discussion comes from observing the development and refinement of University curricula for Industrial Technologists and the concurrent explosion of supervisory training programs, particularly in the private sector. Certain questions began to appear and the most general ones seem to be "What are the implications of supervisory training for technology curricula in four-year degree programs?". Many related questions began to add to the intrigue. Will our Technology majors be reporting to supervisors, either during co-op placement or during the initial years of employment? Will they be assuming supervisory responsibilities? Will they be aspiring to become supervisors? And will they be looking beyond entry into higher levels of management? If the answer to any of these questions is "yes," then we ask if that means that we should address these experiences or goals in the four-year curriculum. If it appears that there are knowledges, skills and attitudes of supervisory roles that should be in the curriculum, where are they found, and how are they organized? Do we make some assumptions about the general education component of the four-year degree as it could make contributions to supervisory competencies? What about courses in management and business administration? Will the co-op educational experience be sufficient to bring out the necessary skills and understandings of working for, with, or as supervisors? Is this a concern or a responsibility of the technical component designers of the curriculum. Can the principles of supervisory training be designed into an academically credible university course or workshop? Should they be?

This discussion paper will not provide specific answers to these questions but is intended to form a basis for serious discussion in the design of curriculum to meet the career expectations of Industrial Technologists during the vestibule years of their profession. The discussion looks at the basis of supervision and its growth from informal, on-the-job training, to legitimate professional development. Typical content areas are identified from a variety of sources and resources for curriculum development are also listed. Finally, the case is presented for analyzing what technologists do and to what degree do these tasks represent supervisory competencies. If the findings justify further consideration, serious curriculum development, should center on content practices and delivery systems to carry out the mission. This may result in units, courses, co-op education placements, workshops or other forms of delivery. In a world where even technologists spend increasing proportions of their time interacting with co-workers as a part of job expectancies, the leadership and supervisory management skills become increasingly important.

(GRH 2)

"Just-In-Time Production System"

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"ABSTRACT"

Japanese manufacturers have rejected the American complex management theories-the obsession with programs, with controls, with computers and information processing, and with mathematical modeling. Instead of developing complex situations, the Japanese way is to simplify the problem.

The simple but ingenious production management and quality control approaches developed by Toyota and other leading manufacturers traveled easily to other Japanese firms without really being taught in Japanese business schools or promoted by consultants.

The aspect of the Japanese system dealing most directly with productivity is known as the just-in-time system. Essentially, "just-in-time" or on demand production means producing a certain quantity of products or materials, in a certain place, at a certain time. As one of the leaders of this field has put it, Japanese industry produces small quantities "just-in-time"; Western industry produces massive quantities "just-in-case."

The J.I.T. ideal is for all materials to be in active use as elements of work in process, never at rest collecting carrying charges. It is a hand-to-mouth mode of operation, with production and delivery quantities approaching on single unit.

When J.I.T. is in operation, there is no particular need for supervisors steeped in behavior-modification lore to provide pats on the back. The consequences of worker's workmanship are visible quickly and are their own reward or penalty. Under J.I.T., if a part doesn't fit at the next work station, the worker who made the bad part will probably not find it hard to guess what he did wrong. In short, the worker's awareness of defect causation is heightened.

Western observers have marveled at how Japanese workers come to one another's aid to resolve problems. We might expect such behavior in a J.I.T. plant, because with small-lot-size inventories, one worker's problem threatens to bring subsequent processes to a halt. So it is natural for each affected worker to aid the worker whose drive belt breaks or whose machine is jammed.

Statistical Process Control - Backbone of Quality Assurance

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ABSTRACT

Today one of the most talked about subjects in the American industry is Quality. This presentation deals with the definition of quality, its characteristics and the principles behind developing a process control based on statistics, which will ensure consistent quality in products.

The quality of an engineering product simply depends on the quality of design and quality of conformance. The simplest and least costly design that will meet the user's requirements is the best design. Assuming that this objective has been met, Quality Assurance deals with all the actions necessary to provide adequate confidence, that the product will meet the user's needs. Manufacturing engineering should determine the capability of various processes and properly match the job and process to ensure that the process can hold the tolerances on a typical job. Once this is done, all that is needed is a method, to ensure what was intended is being followed consistently so that all of the output from the process will be well within the specification limits of the job.

All these require an understanding of the statistical distribution, commonly known as the normal distribution and two parameters associated with it, called mean and standard deviation. Every normal distribution distributes itself about its mean, with its spread controlled by its standard deviation. The output of any production process can be expected to follow a normal distribution. Any normal distribution having its own mean and standard deviation can be compared to the standard normal distribution which has mean of zero and a unit standard deviation, through the factor Z. An advantage of the normal distribution is that the frequency or the number of observations of the distribution that falls above or below a certain level of its standard deviation can be estimated, based on the calculated mean of a sample, using the factor Z. Also, about $\pm$ 3.5 or seven times the standard deviation covers the entire frequency of the distribution. Process capability is defined as six times the standard deviation of the process itself, when the distribution is normal. Under such conditions, if the job and process are matched such that the process capability is less than the specification limits on the job, with the mean of the process properly centered at the middle of the specification, all the output from the process will conform to the specifications. Then, the task is to see that the mean of the process does not shift from the middle of the specification and the standard deviation of the process remains constant. To achieve these objectives, control charts are devised. After the job and process are matched, about 15 to 20 samples, containing 5 to 10 units in each sample depending on the inspecting facilities, are taken. From these samples, the process mean and standard deviation are calculated. Control limits based on plus or minus three standard deviations, the mean and standard deviation of all samples are drawn on graph sheets after selecting a suitable scale.

Samples that fall outside the limits are eliminated from the chart after establishing genuine reasons. After elimination, the control limits are revised and the entire charting process is repeated until all points fall within control. The control charts established, based on these principles, help to ensure that the entire production confirms to the specification. After the charts are established, samples are taken from the process at regular intervals and the mean and standard deviation (range in the case of small samples) of the samples are calculated. These data are plotted on the charts to detect any changes in the shift of mean and standard deviation. These techniques apply to variables, an entity that can be measured by some units of measurements. Control charts can also be established for attributes, an entity that can only be counted by its presence or absence like, the number of defects per unit. Two charts are used to control a variable to track changes in mean and standard deviation separately. Only one chart is used to control an attribute. The control limits on these charts are revised whenever a set up is changed on the process and extended into the future to cover the next twenty-five to thirty samples. These statistical process control charts assure uniform quality on the entire production. They minimize the producer's and consumer's risks. In mass production, they are extremely useful in maintaining quality at the source itself, as operators can be trained to plot the charts and stop producing once the samples show a drift, thus avoiding wasteful production. These are some of the advantages of statistical process control over traditional acceptance sampling techniques. Many industries have turned to these techniques for an assurance in quality of conformance.

Automatic Communications Between 'Intelligent' Machines

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ABSTRACT

Traditional methods of point-to-point communications, whether voice, teletype or Morse code, rely on relatively low data rate exchanges. However, the widespread use of digital computers has created a desire for faster and more reliable data transfer to occur. Various interconnecting schemes such as star, ring and mesh configurations have been attempted to allow several devices to communicate over the same channel. Both time division multiplexing(TDM) and frequency division multiplexing(FDM) may be used to increase channel capacity.

In an effort to find still better ways to utilize the spectrum without switching, packet techniques using radio and coaxial cable networks have been developed. Because there are differences between computers they have difficulty in 'talking' to each other. To solve this problem local area networking(LAN) was created; which employes packet-like communications to transmit data. An international standard, X.25, was developed by the Consultative Committee for International Telegraph and Telephone of the International Telecommunications Union(ITU). Application of this protocol in industry enables manufacturing facilities in widely separated locations to have easy access to a common data base. Examples of commercial computer networks are TYMNET and TELENET, which allow thousands of users all over to communicate with one another. ETHERNET, the type of local area networking pioneered by the Xerox Corporation, even allows the transmitting station to listen while talking.

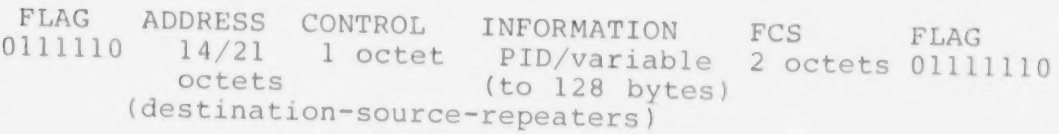
This presentation will discuss the concepts and techniques used to enable automatic communications between and among 'intelligent' machines. Local area networks use serial digital packet formats in the 50 kilo-bit-per-second range. A packet consists of binary data (which might be ASCII, Baudot, or some other code), handled by a network in a defined format, including a header and having a maximum size and data field (see figure-1). Extra information inserted in each packet enables the receiving station to verify automatically that the packet was received without error.

To illustrate the computer-to-computer communication which is currently possible an Amateur Radio packet station will be used. A terminal node controller(TNC), operating with the AX.25 protocol, will be connected between a laptop type portable computer and a radio transceiver(operating in the 144 MHz amateur radio band). Another packet station

will be on the other end of the short-wave linked system; several stations may well participate, depending upon availability at the time of the demonstration.

It is expected that the material presented will give the audience a basic understanding of local area networking; provide them an opportunity to view a demonstration of what is currently possible in high-speed, wide-area data communication systems; and receive additional information on an exciting facet of our new industrial revolution.

Figure-1.



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Energy Management Control Systems

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ABSTRACT

Energy Management Control Systems (EMCS) are programmable electronic controllers used to control interior building environmental equipment. In 1984, 66 billion dollars were spent lighting, heating, and cooling the 2¼ million commercial buildings in the United States. EMCS can reduce this cost by 10 to 25 percent. Energy Management Control Systems reduce building energy consumption by controlling heating, ventilation, and air conditioning (HVAC) equipment with a precision not possible with manual and mechanical means.

The principles of EMCS have been known for years. It wasn't until the mid 1970's when oil prices began to rise and computer equipment began to decrease in price and size that these systems became practical, however. Nationally, billions of dollars have been spent in the last decade to improve the energy efficiency of buildings and the equipment within them which consume energy. Building owners are just now beginning to take advantage of the savings made possible by EMCS. According to the National Institute of Building Sciences, there were approximately 49,000 Energy Management Control Systems in use in 1984. This represents less than two percent of all commercial buildings presently in existence. EMCS growth is projected to be nine percent per year through 1991.

Numerous techniques are used in EMCS to achieve energy savings. The more common of these include scheduled start-stop, optimum start-stop, duty cycling, demand limiting, day-night setback, economizer, enthalpy, ventilation and recirculation, hot deck-cold deck reset, reheat coil reset, steam boiler optimization, hot water optimization, hot water outside air reset, chiller optimization, chiller water temperature reset, condenser water temperature reset, chiller demand limit, and lighting control.

Energy Management Control Systems are available in different sizes to meet the needs of almost any type of building or building complex. These have been standardized by the EMCS Guide Specifications which have been developed by the U.S. Government and energy management vendors. Four different sizes have been identified by this group as defined by the number of input/output (I/O) monitoring and control ports and include Micro EMCS (less than 125 ports), Small EMCS (50 to 500 ports), Medium EMCS (500 to 2500 ports), and large EMCS (more than 2500 ports).

A typical EMCS is composed of a Central Control Unit (CCU), a programming unit, and a display unit. The CCU contains a Central Processor Unit (CPU), usually in the form of a microprocessor, ROM, and RAM. The bulk of the program is stored in ROM while the operating variables are placed in RAM. Push-button switches, keypads, or keyboards for the programming unit while LED or LC displays, video monitors, and printers are used as display units. Data is sent to the CCU in serial fashion and may be either analog or digital in format. Input data may include temperature,

relative humidity, dew point, pressure, flowrate, current, voltage, electrical power, electrical energy (KWH), and energy usage (BTU). The data can come directly from the monitoring points within the building or be sent through a multiplexer. Output data represent control signals which operate pilot relays, contactors, solenoids, and torque motors.

An Energy Management Control System can be installed in almost any type of building. Although the initial market was aimed at very large buildings, 200,000 ft^2 or more, systems can be justified in buildings as small as 8,000 ft^2 today. Typical buildings include retail stores, supermarkets, office buildings, hospitals, schools, industrial plants, and multiple residential units. A building is a good candidate for EMCS if its energy cost forms a substantial part of the overall operating costs, if its occupancy schedule varies from day-to-day, if its management does not want staff controlling HVAC equipment and lighting, and management wishes to have a record of HVAC performance and operation.

Other methods of handling energy monitoring and control functions should be considered before making a decision to install an energy management system. Assigning a staff person to turn lights and HVAC equipment on and off at an established schedule or connecting lights and HVAC equipment to 24 hour or 7 day clocks which automatically turn equipment on and off at present times should be investigated.

Before installing an EMCS, an energy audit should be performed. The result of this analysis will determine the compatibility of an EMCS with existing lighting and HVAC equipment; it will identify those monitoring and control systems which are performing well and can be left as is; and it will identify areas where an EMCS can improve operation.

After an EMCS has been installed, a number of factors must be considered if the system is to be successful. Success implies that the system has been properly installed, is reliable, provides the needed functions, and saves energy as projected.

In conclusion, an Energy Management Control System is a tool. It will only be as useful as the interest taken in it by the building personnel. This is affected by their knowledge of the EMCS capabilities and their care in using the system.

CAD Systems for Smaller Schools/Industries: How to Utilize PC's for CAD Applications

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ABSTRACT

Computer-Aided Design, commonly known as CAD, is becoming an essential part of today's technology. Not so long ago CAD was MAINFRAME, and only a few could afford it. Personal computer CAD offers application in mechanical design, electronic design, and architectural design.

A CAD System is usually a combination of computer software, hardware with input/output devices. There are approximately 22 different commercial CAD software packages on the market that have a wide range of applications and costs. Choosing a CAD program that would satisfy your engineering need may be confusing. To help you to select a right CAD the following FOUR STEP METHOD is recommended:

FOUR STEP METHOD

STEP I

What do I want my computer for?
What type of software?

- Personal
- Management
- Education
- Entertainment
- Scientific

STEP II Software Evaluation:

- Ease of Use
- Special Requirements
- Usefulness
- Support
- Warranty
- Hardware Requirements

STEP III Hardware:

Computer
Monitor
Keyboard

STEP IV Input/Output:

Digitizer
Plotter
Printer

SPEED

The majority of CAD software require a speed of faster-than-standard. To increase the speed of your PC, you may consider the following options:

Floppy versus Hard disk
Math co-processor (8087,8087-II,or 80287)
Turbo Card

COMPARISON

AutoCAD,Version 2.5
CADKEY, Version 1.2
CADVance, Version 2
VersaCAD, Version 5

CONCLUSION

A careful review of the FOUR STEP METHOD should provide guidelines for selection and utilization process of a CAD system.

The Global Influence: A Major Corporation Responds

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In 1984 the Dana Corporation conceived a plan for its North American, South American and European plants, and selected divisions to respond to increasing global competition in its vehicular and industrial markets. Now in practice, the plan known as "Project 90" charges plant managers and Dana employees to become "...#1 in technology; #1 in quality; and the low-cost producer." This energetic project is affecting over 36,000 employees on three continents in over 250 manufacturing facilities. The means to achieve these goals are two-fold. First, through capital expenditures for new and improved manufacturing technology, such as improved machine and system operation, machining cells, and plant layout changes. Second, a commitment by Dana people at all levels to do the job better through personal involvement, training programs and gain sharing plans to name a few.

Some examples of Project 90 implementation include the Minneapolis, Minnesota fluid drives Gresen Valves Plant where total manufacturing time in one operation was reduced from 29 days to three. In Pueblo, Colorado the Engine Products Manufacturing facility reduced inventory by 80% while increasing productivity 300% through machining pistons in cells.

Then too, the impact of heightened concern for improved product quality has brought results. The Spicer Axle Division reduced quality-related defects on its Jaguar XJS axle by 80% compared to the automaker's previous supplier. Dana's heavy duty truck marketers provided a three year, 300,000 mile warranty covering their heavy duty drive train system.

Perhaps most significant is the corporate approach referred to as the "Dana

Style." Peters and Waterman write about the "... constant use of the word 'people'" at Dana in their popular management analysis of America's best-run companies titled, In Search of Excellence. "Caring," they write, "runs through the veins of the manager..." But there is more to the "Dana Style." It is summarized as ..."working hard to keep it simple. Working hard means productivity, market penetration, and excellence. Keep it simple means doing away with large staffs and complicated procedures - letting Dana people who know the job best do it."

It is too soon to judge the effectiveness of "Project 90", but early indications appear to suggest that the big gains will be made by "technology that has practical, everyday applications in our factories, warehouses and offices." While "high technology" has a role in the future of Dana, its influence will be felt more strongly in the years that follow.

Color Imaging Technology: Applications for Graphic Communications

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ABSTRACT

This presentation focuses on digital imaging technology as it relates to color applications in graphic communications and specifically graphic arts. A variety of systems are explored in terms of current applications opportunities and the potential for additional activities with such systems related to: 1. Digital imaging technology for color computer assisted design, printing, and publishing, 2. Computer aided publishing (CAP) systems in the graphic arts industry, and 3. Image design and image generation functions appropriate to graphic arts concepts and industrial applications.

Applications of Imaging Technologies

	Computer Aided Design/Drafting	Printing & Publishing
Archival/Storage	×	×
Artwork/Drawings	×	×
CAD/CAM	×	
Color Separations		×
Computer Animation	×	×
Documents		×
Film/Slides (B/W & Color)	×	×
Graphics	×	×
Interior Design	×	×
Line Art	×	×
Logos & Fonts	×	×
Mapping	×	
Photographs (B/W & Color)		×

Concepts and applications of digital imaging technology utilized in industry must be brought to the school setting. It is essential to integrate appropriate applications into the graphic communications segments of Industrial Technology Departments. New digitizing technologies have revolutionized the graphic communications world. The availability of inexpensive, efficient systems for dealing with images will fundamentally change the content ratio of printers work and the way we communicate in our business and

personal lives over the next few years.

The key areas of digitization technology are: 1. Image acquisition, 2. Image processing, and 3. Image recording. Image acquisition involves the capture of information in one form or another from the outside world. All information which was not initially created on an electronic graphic system must either be acquired or restructured in order to be processed by such a system. Raster scanning and vector digitization are the two basic methods available for converting images into electronic form.

Enlargement, reduction or the manipulation of image data come under the heading of image processing. Until the last five years, image scanning was linked directly and physically with image scanning and image recording. It was cost effectve to build machines this way during the era when computers were expensive. Once high volume, high speed disks and potent microchips became less expensive, the hardware linkages between scanning, processing, and recording of images were almost immediately replaced.

Like image processing, image recording has flourished since the separation of components. Once the data which are to be recorded are available as output from image processing a variety of recorders can be used. The processed image can be recomputed at different resolutions and output by a laser/ink jet printer or other recording device. The great advantage of making hard copy output from digitally processed images is that a variety of output devices can take the same data stream. For example, a new generation of graphic arts recorders put text and pictures onto plain paper for proofing, film or RC paper for traditional platemaking, or directly onto laser-sensitive plates.

An important question we must ask is "What impact will digitization have on industry over the next ten years?" While color production systems have been evolving and maturing at prices approximating $1 million, the world of low-cost computer graphics has also been developing at breakneck speed. One of the most intensively researched applications has been the automation of the graphic designer's task. Systems usable for creation of advertisements and other color, image and type-intensive communications have been under development for years. Color workstations are being created which will become "editional" components of totally integrated digital networks producing high-resolution digital images for printing and electronic distribution. We are witnessing a revolution in graphic communications systems especially in the printing industry: progress in automation from its initial task in mechanization of functions to a total rationalization where all system functions derive from the actions of the creator. The ability to adapt to digital technology is there but the technology clock is ticking much faster now.

THE ILLINOIS PLAN FOR INDUSTRIAL EDUCATION

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ABSTRACT

The Illinois Plan for Industrial Education has been evolving for almost a decade, and the process continues. In 1978, industrial education leaders in Illinois realized curricular changes were needed. The latest State Guide for Industrial Education had been published in 1963. Thus, the Industrial Joint Staff made up of representatives from each university with an industrial education program, State Department of Education personnel, the Illinois Council of Local Administrators (ICLA) and the Illinois Industrial Education Association (IIEA) wrote a perspectus for funding the development of a new State Guide for Industrial Education. This perspectus was reviewed by the Illinois State Board of Education (ISBE)/Department of Adult Vocational Education (DAVTE) and served as the model to develop a request for a proposal. Dr. Henry Sredl of the University of Illinois responded by submitting a proposal to write a new State Guide for Industrial Education.

This initial effort began with the formation of extensive advisory committees with representation from business and industry, as well as education. The central purpose of these meetings was to determine **what should be** with respect to Industrial Education. This important activity provided a basis for the K through Adult model that eventually developed. Based on the input received through this process, a new state guide was written. The first draft of this document was not disseminated on a statewide basis. It was rather lengthy (300 plus pages) and lacked the necessary graphic illustrations to make it easy to use.

In 1980, Dr. Sredl went on sabbatical and was thus unable to continue the project. The Industrial Joint Staff felt the project was too important to be "shelved" and made the strong recommendation to the State Department that the project should be moved to Illinois State University. This recommendation was favorably received and so, the following year, a 28 page planning guide was developed. The planning guide was to give direction for curriculum development activities for the years ahead. All curricular activity was to be based on the K through Adult model depicted in Figure 1. After careful review, it was decided to initiate curriculum activity at the orientation level. This

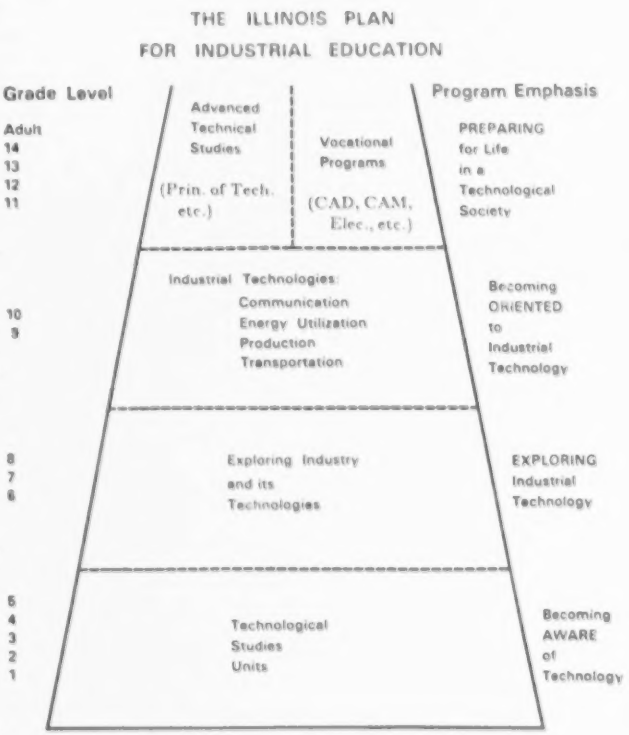

Figure 1

appeared to be the area of the curricula in most need of improvement. Therefore, in 1981-82, four pilot schools were selected with each having the responsibility of writing one one-semester orientation level course. The following year, these courses were tested in twelve schools throughout the state. Meanwhile, efforts were begun to write the first draft of 24 three week units for the exploration level (grades 6 through 8).

During the 1984-85, four orientation level courses in the technologies of Communication, Energy Utilization, Production and Transportation were published and disseminated. Sixty-four orientation workshops were held throughout the state and a high percentage of the teachers involved with ninth and tenth grade students were able to obtain curriculum materials at no cost. Also, the universities throughout the state began to offer in-service classes for teachers on how to implement the Illinois Plan for Industrial Education in their particular school. And, promotional materials were professionally designed to help inform councilors, administrators, parents, and students of the changes that were occurring in the curriculum. During the past year (1985-86), a new newsletter entitled **Technology News Today** was published four times to inform teachers of changes occurring in Industrial Education. Additionally, hands-on workshops were conducted in 26 locations around the state. These workshops were designed to help acquaint teachers with new technologies such as lasers, robots, and appropriate computer software. The development of curricula in the area of computer-aided drafting, computer-aided manufacturing and electronics was initiated under the direction of Jule D. Scarborough of Northern Illinois University.

This year, the publication of **Technology News Today** continues, plans are to finish and disseminate the junior high units, and to revise the original planning guide. Further, hands-on workshops will be conducted and the Principles of Technology is being piloted in nine schools throughout the state.

Although most of the human and financial resources over the years have gone into curriculum development activities, the project has had marked influence in other areas as well. For example, all universities have agreed to follow the Illinois Plan for Industrial Education in their pre-service programs. Further, the universities have agreed to use the same syllabus in the in-service courses. Another impact has been in the area of certification. Currently, certification requirements are being altered to reflect the changes in curriculum advocated by the Illinois Plan for Industrial Education. The IPIE has also had an impact on funding. The ISBE/DAVTE has made it clear to the local education agencies that in the future, funding is likely to be based on the Illinois Plan for Industrial Education.

Probably the most far reaching impact of the project has been the coordinated effort between teachers in the field, state department of education personnel, and university faculty members. All of these groups now have a base upon which to cooperate and thereby do their part to improve industrial education for the young people in Illinois.

"Graduate Education in Industrial Technology: Programs and the Future"

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ABSTRACT

In the fall of 1985, the graduate student enrollment in the Department of Industrial Sciences was 35, of which only three were enrolled in the Manufacturing/Industrial Technology program concentration. The enrollment had declined in the department and stabilized at a low level, particularly in the Manufacturing program. The program was a series of five traditional technical manufacturing courses with the exception of one "robotics applications" course, and recommended elective courses. The faculty was directed by the Department Head to update the curriculum. The department was required by the university administration to cut courses and combine all three master's programs (Manufacturing/Industrial Technology, Construction Management, and Industrial Sciences and Technology Education) into one degree with an efficient core curriculum and separate areas of specialization. The process was not easy since three program faculties had to agree to the same departmental core courses. This required several meetings of a task force and several heated faculty meetings. The results are an efficient master's degree program.

The enrollment increased to forty-five students for the fall of 1986. Over 33 inquiries have been received concerning the Construction Management master's degree program. The required courses in the new Manufacturing/Industrial Technology concentration include computerized industrial controls and artificial intelligence; robotics and flexible manufacturing systems; computer-aided design; and computer-integrated manufacturing. Elective courses in manufacturing planning and administration; nontraditional manufacturing; and computer-aided manufacturing are also available for students who lack a solid background in manufacturing.

While our master's program was being redesigned, a major recruiting drive was established, and publications and posters were designed and printed. One of the sources that was reviewed was the NAIT directory to determine which schools had master's programs and large schools which did not have a master's program to offer their students. Of the 136 schools in the 1985-86 directory, only 34 have indicated that they have master's degree programs available. Not all of the master's programs are Industrial Technology (IT) programs. Listed below are the titles of these programs, the number of undergraduate students at these institutions, and the number of graduate students enrolled at these institutions. The number of schools in each group is also listed.

Major Master's degree Programs Classifications and Undergraduate and Graduate Enrollment at These Institutions

	Undergraduate	Graduate	%(G/U)
Industrial Arts or Industrial Ed. (12 schools)	4,290	323	7.5%
Industrial Technology (15 schools)	5,128	260	5.0%
Schools that offer IT and IA (3 schools)	1,841	358 IT 50 IS	19.0% 2.0%
Industrial Supervision or Organization and Management (3 schools)	2,634	321	12.0%
Engineering Technology (1 school)	125	45	36.0%
Totals 34 schools	14,018	1,357	9.0%

Additional information which should be noted about this table is that three of the Industrial Technology schools (second category) listed the program as available but reported no enrollment. Also, enrollment of the combined IT and IA group (third category) was largely attributed to one school that had 1,171 undergraduate, 333-IT and 18-IA, students. Although the best percentage is represented by the engineering technology category, this represents only one school. What is most significant about this table are the totals and final percentage which is nine percent. Based on this figure, a graduate program should have an enrollment of nine percent of the undergraduate enrollment at that institution to be consistent with the national average. This gives us a planning figure for program development. An additional finding was that the total enrollment in bachelor's degree programs for all schools was 35,139 students. If the nine percent figure is correct, then there is a potential of 3,162 graduate students of which only 1,357 are now being served.

The CSU faculty is giving serious consideration to the development of a doctoral program in industrial technology. Our contacts indicate that there is a need for an innovative, nontraditional education program that could serve the needs of industrial technology and engineering technology students. A combination of course requirements which permit study off-campus, as well as on-campus to meet residence requirements, could be developed for this group.

"A User Versus a Doer: Training Variations in CAD"

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Training options in Computer-Aided Design are as diverse as the products on the market. As a student who wants to learn CAD, or as a company who wants to train employees on a new system, your educational choices are extremely varied. Comparisons of programs can be made by considering these factors; cost and length of time spent in class, method and facilities used in the presentation, depth of topics covered, and range of application experiences acquired. The bottom line in the selection is the degree of functionality - how quickly and accurately the system can be working for you.

Industrial training falls in two categories:

A. In-House: Specialized personnel are contracted to customize the new system, write application code, then develop the training manuals and programs for company employees. The process takes months, and is extremely expensive. Workers barely become proficient before new products are acquired.

B. System companies: Training classes often are a part of the purchase or maintenance contract. Separately, the cost of the training ranges from $200/day to $1250/week per student. The classes are held at the product company facility, run by a specialized trainer guiding students through training manuals. Students work on the most recent equipment. Classes are very topic specific such as; graphics for the NCG user, finite element analysis, computer operating system commands.

Computer-Aided Design software companies:

A. Mainframe CAD software companies offer training programs at their headquarters. Classes include the short topic style described above, or a two-month intensive session. That trainee becomes a system specialist, but often needs an additional few months to become competent.

B. PC-software companies offer the greatest variety of options. On the low end, the company supplies technical manuals with purchase. In addition to these, you may purchase audio or video tapes, training cookbook manuals, programmed learning software, or classes at various college training centers. The cost varies. The use of the product is covered to the extent of the student's efforts, but little effort is spent on applications.

Training companies and Special Interest Groups:

A. A newer option in CAD training is the Consultant training company. Training contracts are developed to your specifications, and done at your facility, or a training site. The cost and type of training is totally customized.

B. Professional societies offer many training seminars or special topic sessions at conferences. These involve a two hour review of products and some usage explained on an overhead. Students may review skills or pick up a tidbit.

Technical schools and Associate degree programs:

A. The media bombards us with promises of computer competency in 6 months! These programs rarely include CAD. Most technical schools offer drafting classes using one brand of CAD software and equipment. A typical 34 week program does half in the classroom/lab, half on the job.

B. Community colleges offer associate degrees such as 'drafting technology' or 'computer-assisted drafting'. Students pay $100+ per 3 credit course; and there are 2 - 6 courses in the degree. Typically the classes of fifteen students are lecture/lab style. The lab may have 6 -12 stations or personal computers. Usually the software and equipment is out of date or down-sized. Students do a variety of drafting exercises, some programming, and become fluent on one or two CAD packages.

Engineering and CAD degrees:

A. Colleges with engineering programs incorporate CAD into the degree as a tool for design and analysis. Their use of CAD is expanding. Some universities have impressive research computer facilities to develop more solid modeling and analysis options. The majority have such an intense curriculum that little is taught about CAD itself assuming the student will learn it on the job.

B. A four-year CAD major degree produces the most capable doer; a student who can adapt to new systems and customize them more readily than the user of one system. A semester 3 credit course costs $200+ for 60 hours of lecture/hands-on lab instruction. Four background topic areas are incorporated in the 120+ credit hours program:

1. Manufacturing - metal processes, materials, machine tools, electricity, manufacturing organizational theory and a variety of computer applications.

2. Academics - mathematics (some calculus), physics, chemistry, management, economics, and technical writing.

3. Drafting & Design - at least two drawing classes including descriptive geometry, and an advanced course using a CADD system for applications.

4. Computer Science - four languages, computers used (micro, mini, mainframe), data bases, and experience on many CAD packages, CAD macros, routines, interactive programs, and doing problem solving, and set-up exercises.

As Computer-Aided Design develops, training programs will grow and improve. Weighing the options' merits is a monumental task. Research and envision the results you are expecting before you select a training program.

Planning for Mid-Volume, Mid-Variety Parts Production

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ABSTRACT

It has been estimated that about 75% of manufacturing activities in this country are in batches of approximately 50 units. This fact, plus the need for a low-cost solution that provides for quick product start-up, and the ability of the system to accommodate a variety of part configurations, and quick response to changes in demand and design have made flexible manufacturing systems (FMS) an ideal candidate for the solution to some of the problems associated with traditional mid-range discrete metal part manufacturing.

In its most basic form, FMS can be defined as: A COMPUTER CONTROLLED MANUFACTURING SYSTEM UTILIZING SEMI-INDEPENDENT NC MACHINES LINKED TOGETHER BY MEANS OF A MATERIAL HANDLING NETWORK. While NC machines provide the flexibility for machining operations, the computer continuously monitors the activities of the equipment and provides supervisory and engineering reports. The tool of simulation can be utilized effectively to predict the behavior of the system components, and, therefore, take appropriate corrective measures when needed.

FMS, as a whole, is very attractive, but this attractiveness has mislead some users. Because of improper planning, some of the FMS installed, failed to meet the users' expectations and resulted in excessive costs. FMS is a complex system and its successful design, installation, and operation require extensive planning and cooperation between the users and sellers.

The planning stages of FMS encompasses the areas of setting goals and objectives, work piece selection, choosing production techniques, developing manufacturing processes,identification and selection of machine tools, material handling system, and control system. The planning stages also include inspection techniques, system floor plan development, simulation, manpower requirements, and system expenditure. Each one of the aforementioned stages must be studied in detail and compared to other alternatives. Then the decision may be made for implementation of FMS.

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United States Technology Transfer

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ABSTRACT

The international technology transfer network is a topic that has received much critical analysis since the end of the second World War. At that time, the United States began to export a greater number of manufactured goods to a number of war-torn European nations. On its home front, the U.S. government continued to increase domestic expenditures on military programs and aerospace research and development projects.

This continuous outflow of American technology since the mid-1940s has had a significant influence in the development of contemporary global relationships. In many ways, the transfer of technology from the United States to other countries around the globe has shaped the political, economic and military challenges we are presently confronting. There have been numerous cases where innovative American technology has been the keystone by which other nations have modernized and industrialized.

One interpretation of the term "technology transfer" refers to the development of a technology in one setting which is then transferred for use in another setting. Technology transfer is a process that usually involves a supplier and a recipient; as a result of the transfer, the recipient typically (but not always) attains an improved capability to operate an industrial production facility or service system. Further analysis indicates that technology trade (i.e., industrial rights, equipment, technical services and training, plans, documents, etc.) is only one component of technology transfer. The most critical component involves the recipients'capacities to actually utilize or absorb the technology in question. In some situations, it appears that technology is more easily "traded" internationally than it is "absorbed" by the recipients who reside in developing countries. Stated differently, not all "high-tech solutions" can be implemented effectively in all social settings worldwide. The suppliers of technology often lose sight of this fact.

This state of affairs is the focal point of one end of the international "tech-transfer continuum." The opposing end of this continuum is characterized by covert activities designed to acquire technology from the suppliers who are either unwilling or not yet ready to release it to these anxious recipients. In other words, technology transfers evolve throughout a complex and somewhat controversial network of activities. At one end we can reference the uncritical transfer of technology to reluctant recipients; at the other end, we find reluctant suppliers who are caught amidst a web of high-tech espionage.

An evaluation of current trends in the transfer of United States technology abroad demands a basic understanding of both the motivations for these transfers and the types of channels used to execute them. Several key concepts are discussed in response to this objective including: foreign direct investment, licensing, turnkey plants, reverse engineering, appropriate technology and the imitation lag-demand lag cycle.

Some observers believe that the ongoing upward spiral of technology transfer activities has placed the United States in a precarious position. The U.S. may very well be in danger of losing its technological edge in several areas of manufacturing and production. There is little doubt that the globalization of production is reshaping as well as reducing the U.S. manufacturing base. To what extent is the increase in offshore operations being directed and controlled by the United States? Conversely, to what extent are United States companies being dismantled by the industrial activities initiated among overseas competitors? Is the "Made in America" insignia quickly becoming a symbol of the past? Several examples of recent U.S. technology transfer scenarios are presented to provide a foundation for the discussion of these and other important inquiries.

Just-In-Time Manufacturing

Mr. Fred E. Meyers
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Carbondale, Illinois

ABSTRACT

Just-In-Time Production and Inventory Control is a new philosophy of management that affects every area of a business. Just-In-Time Manufacturing is only part of the total program, but this one part has great impact on plant layout, material handling, tool design, work methods, and other operating procedures.

Goals of Our Just-In-Time Manufacturing Plan:

1. Have as little work in process as possible.
2. Move the material as little as possible.
3. Move material automatically when moving is required.
4. Combine operations.
5. Eliminate bending to pick up parts.
6. Balance the plant for 2400/shift @ 120%.
7. Straighten out the material flow.
8. Eliminate manhandling bulk material and finished goods.
9. Speed up changeovers of tools, dies and packout.
10. Commit machines to one part as much as possible.

Goals of This Presentation:

1. To describe what J.I.T. Manufacturing is.
2. To describe the installation of J.I.T.
3. To review results.
4. To review problems associated with J.I.T. Manufacturing.

"Statistical Process Control: A Major Component for Industrial Technology"

Dr. Patrick W. Miller
University of Missouri-Columbia
Columbia, Missouri

Mr. George Schmitz
John Deere Hydraulics
Waterloo, Iowa

ABSTRACT

Quality is impossible to ignore. Improved quality leads to improved productivity and lower cost for the American consumer. Five years ago, 48 percent of consumers rated quality equal to price. Today, 82 percent of consumers rate quality with price. Nobody is rich enough to buy cheap (Feignbaum, 1985).

Producing quality products at the lowest cost to the consumer is the primary objective of all manufacturing industries. Consumers satisfied with products will tell approximately eight friends, while unhappy consumers will tell approximately 22 friends. Manufacturing industries are very cognizant of the consumer's desire for quality and are constantly working to improve quality standards.

Purposes

The purposes of this presentation are to (a) examine the current use of statistical process control in manufacturing, and (b) suggest ways to incorporate statistical quality control in the industrial technology curriculum.

Current Use of SQC and SPC in Manufacturing

To produce quality products, manufacturing industries must require (a) management commitment, (b) employee involvement, (c) consumer focus, and (d) training programs in quality control (Petersen, 1985). One quality control tool used by many industries is statistical process control (SPC). SPC uses statistical measures during, not after, the manufacturing of products. Thus, SPC serves as a tool to prevent rather detect faulty products. Figure 1 illustrates a detection system (SPC not used) where inspection occurs after the product is produced. If the product meets standards it is sent to the consumer. If the product does not meet standards, it is reworked or scraped. Figure 2 illustrates a prevention system (SPC used) where "inspection" (through the use of control charts) occurs during the manufacturing (processing) of the product and rework and scrap is eliminated.

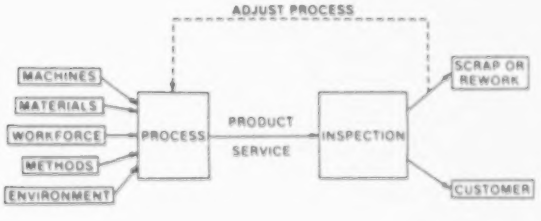

FIGURE 1. DETECTION SYSTEM

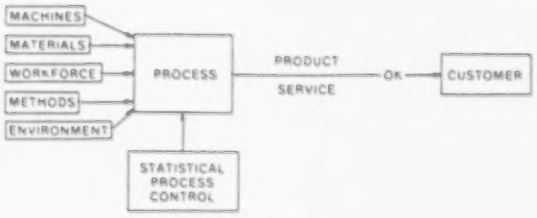

FIGURE 2. PREVENTION SYSTEM

Training must involve all organizational personnel (management and employees) when introducing statistical process control in a manufacturing industry. Personnel can be grouped into "improvement teams" that work together to improve quality/productivity. Members representing improvement teams can include: (a) production supervisors, (b) inspection supervisors, (c) maintenance supervisors, (d) process engineers, (e) material engineers, (f) quality engineers, (g) industrial engineers, (h) personnel from purchasing, (i) skilled tradesmen, (j) production control supervisors, and (k) product engineers.

One of the SPC implementation techniques used by many industries (Deere and Company, Ford Motor Company, Winnebago Industries) is the Shewhart/Deming Model. This model is used by the improvement teams to select a project within the manufacturing industry where SPC can be implemented. Evaluation of the information provided by the SPC control charts can indicate problems and specific improvement strategies can be recommended by team members (see Figure 3).

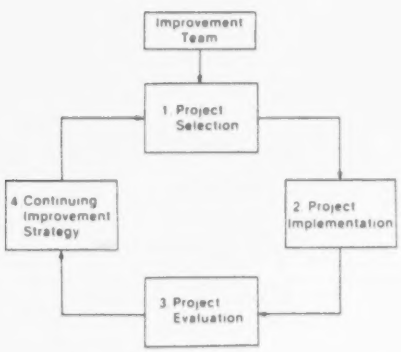

FIGURE 3. MODEL FOR CONTINUOUS QUALITY/PRODUCTIVITY IMPROVEMENT

Statistical Quality Control in the Industrial Technology Curriculum

In order for Industrial Technology to stay current, it is imperative that statistical quality control methods be incorporated into the curriculum. The industrial technology curriculum should include the following areas: (a) nature of quality control, (b) need for quality control, (c) factors which affect product quality, (d) factors that influence quality control, (e) detection vs. prevention systems, (f) quality control circles, (g) basic statistical tools, (h) statistical process control, (i) acceptance sampling, (j) special job studies, and (k) quality control charts.

These content areas may be taught as a separate quality control course or could be integrated into a manufacturing technology course. In any case, these content areas should be required within the industrial technology program.

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Earth Sheltered Residential Construction

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ABSTRACT

Residential construction practices have not changed substantially for centuries in that homebuilders still incorporate above ground - post and lintel - wood frame systems which drain the earth's wood, energy and land resources to name a few. As the worlds' population increases, global resources will become further strained but could be significantly alleviated by building earth sheltered - reinforced concrete - curvilinear structures in that this type of home will utilize less energy and land.

The use of wood as a structural material is virtually nonexistent outside of the residential sector because owners, architects and commercial constructors realize its inferiority. Unfortunately, this expertise is lacking among homebuilders and homeowners. Leaders in the architectural field such as Frank Lloyd Wright and R. Buckminster Fuller have designed many homes which incorporated some elements of earth sheltered - reinforced concrete - curvilinear systems.

The purpose of this paper is to demonstrate that earth sheltered residential construction is resource wise and cost competitive when compared with conventional homebuilding practices. The advantages of earth shelters are well documented and include; long life expectancy, structural superiority, reductions in energy, noise and land, increased security and fire protection to name a few.

Earth shelters are mainly classified as either on grade or sub grade. The disadvantages associated with sub grade earth structures far outweigh its advantages when compared with on grade.

Of the four types of on grade shelters, the elevational (southern exposure) and penetrational (southern and northern exposure) designs are the most popular whereas the chamber and atrium design are the least adopted.

Concrete earth shelters are far superior to wood and steel. Concrete earth structures are typically cast-in-place, however, precast panels have been used successfully. In terms of shape, curvilinear designs such as the dome and barrel vault are superior to flat walls and roof approach.

Concrete forming and placing methods for earth shelters include rigid forms of wood and steel, air supported membranes and earth forms. Air supported membrane systems and rigid steel forms are the most practical for curvilinear shapes. In the latter case, the steel formwork serves as both the form and reinforcement. Air supported membranes carry the concrete load temporarily and are reuseable. Both of these concrete forming systems incorporate shotcrete placement techniques which consists of spraying concrete onto the reinforcement to a thickness of about four inches.

The earth shelter design and construction method that I would recommend consists of the following:

1) barrel vault design (one or two story)
2) air supported membrane for one story and rigid steel formwork for two story structures
3) penetrational design to allow natural lighting from the south and north
4) earth cover of two feet minimum and earth beam on north and south exposed wall
5) incorporate passive solar features
6) incorporate natural air ventilation and earth tubes to precondition air for HVAC system.

The best of all possible sites faces south and has a gentle slope. This allows most windows to be placed on the south side to capture the maximum amount of radiant energy from the sun.

Current research suggests that it may be more cost-effective to build earth shelters in warm climates than in cold climates. An earth shelter can be built anywhere that a conventional home can be built and at a comparable cost of $40 to $45 a square foot. However, the operating costs which by far exceed construction costs favor earth shelters considerably.

Applied Composite Technology in the Aircraft Industry

Dr. John N. Riley
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ABSTRACT

Aircraft construction materials have gone through a steady progression from the wood and fabric planes of the Wright brothers era to the sleek, all metal planes of the post WWII era. The technology that led to the all sheet metal aluminum aircraft is now giving way to the technology of partial or all composite aircraft.

The movement of composites into the aircraft industry has been a gradual process. An early example was the use of an adhesive as a bonding agent for metal to metal fastening such as the wing skins of the Gruman trainers. A further application was the addition of fiberglass wing tips and solid fiberglass landing gear to these aircraft.

Early work in these areas involved the use of "E" glass and epoxy resins. Today it is common place to hear terms such as "S" glass, Kevlar, grafite, pre-preg, and ester resins.

In the early seventies, the homebuilt aircraft industry began the shift to composites. One of the earliest materials was Dynel fabric on a foam and wood aircraft. Later on in the seventies, Rutan Aircraft began selling plans for all foam and "E" glass/epoxy resin aircraft. Rutan's efforts appear to have led the way in what is referred to as "moldless composite sandwich" aircraft construction. Further developments from this composite research have led to all composite Beech "Starship" executive aircraft.

Late in the seventies a mold type of sandwich construction aircraft was introduced by Stoddard-Hamilton. This type of all composite aircraft was produced by using foam and "E" glass/vynalester resin in large molds.

These two types of wet lay-up construction produce strong, light, and highly aerodynamically efficient aircraft. It is from this beginning that the homebuilt aircraft industry has now spawned many new aircraft designs that are totally composite.

While the homebuilt aircraft industry was making its move to composites, both commercial and military manufacturers of aircraft were also experimenting with composites. Names such as Lockheed, Bell and Boeing are now making composite aircraft components. Examples for Boeing include honey comb sandwich control surfaces utilizing Kevlar and carbon fiber. Bell helicopter has long used fiberglass rotors, in fact, Bell is also using fiberglass rotor hubs and is currently developing totally composite helicopters. Their processes revolve around molded CNC woven pre-preg fibers.

There is no question that composites are the new wave of materials for aircraft construction. These materials are not only stronger and lighter than earlier materials, but also have a greater fatigue value. With these new materials the aircraft industry now has the means to build stronger, faster and lighter aircraft which leads to greater payloads for quicker delivery of people and goods.

Geometric Dimensioning and Tolerancing an Interpretation of International Drafting Standards

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ABSTRACT

No other aspect of graphic communications except, perhaps, Computer-Aided Drafting and Design, has impacted industry nationally and internationally as much as the "new" International Drafting Standards (ISO). Geometric Dimensioning and Tolerancing is a major component of these new standards. All aspects of technology have been affected including educational programs, industry, business, and the writers of technical information such as textbook and magazine publishers.

Geometric Dimensioning and Tolerancing is truly having a global impact on technology. The symbolic nature of the International Drafting Standards combined with Computer-Aided Drafting and Design, has revolutionized the way we communicate and the way we produce products in an automated society. Indeed, Geometric Dimensioning and Tolerancing is considered indispensable when specifying and controlling precision specifications required in todays design, production and inspection procedures.

Although Geometric Dimensioning and Tolerancing is a major component of the International Drafting Standards and the application of geometric tolerancing has received wide acceptance in recent years, there remains confusion regarding the application of the standards. Much of the confusion is due to inadequate in-service and preservice training. Frequently when industries have provided in-service training, only one group within the industry has been involved. Geometric Dimensioning Standards affect engineering, manufacturing, and quality control. It accomplishes very little to train personnel in one of these groups and not provide similar training to others. Often Engineers and Designers receive training but the machinists and quality control personnel do not. Preservice training in Geometric Dimensioning and Tolerancing is often not available to students enrolled in programs where the instruction is needed. Educational institutions have been slow in implementing training in Geometric Dimensioning and Tolerancing. Few schools of engineering or technology offer more than a brief introduction to the subject.

A crucial problem is the nature of the training programs that are offered. Typically the instruction is not indepth. Most programs deal with the basic theory of the science and do not provide instruction in the actual implementation of the standards. Another weakness of most training programs is the failure to deal with implied and invoked controls that accompany the specified controls in feature control frames. Often the implied and invoked controls totally change the apparent meaning suggested by the specified controls. As long as "loop holes" remain regarding the need to specify MMC and RFS modifiers, zone

indicators, and the implementation of RULE #1, there will be confusion for those who only read "what the note says." There are large numbers of drawing files that were made during previous periods when the symbols and principles of application were different than they are today. The person with an indepth understanding of the underlying principles and applications of the science will have little difficulty reading these drawings. Often a haphazard approach to Geometric Dimensioning and Tolerancing can create an illusion of knowledge which can be disastrous when working with implied commands and old drawing files.

Another problem with our current educational efforts is the lack of understanding of the effects various controls have on different areas within the industry. Although Geometric Dimensioning and Tolerancing purports to better specify the design intentions of engineering throughout the industry, dimensional controls are often specified during the design and specifications phase with little concern for the impact these controls have on manufacturing and quality control.

Until training programs provide instruction to all people impacted within the industry, and until the programs are comprehensive and indepth there will remain much confusion regarding the utilization of the new international drafting standards.

"Artificial Intelligence - Fundamental Concepts and Techniques"

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Fort Collins, Colorado

Dr. John R. Sutton
Colorado State University
Fort Collins, Colorado

ABSTRACT

Artificial intelligence is a conceptual procedure which is now affordable in programs of Industrial Technology. Frightfully expensive and complex in past years, the software/hardware configurations necessary to initiate AI are now priced at a reasonable rate.

Our faculties must have a basic knowledge of AI (Expert Systems), access to the computer, and a suitable AI software to begin elementary AI activities in classes and research.

The proposed presentation is designed to inform the educator that AI (Expert Systems) are now available and what he must know to initiate activities in this area.

Program Outline:

I. Explaining Artificial Intelligence - What is it, and where is it now!

II. Current Applications of AI

III. Hardware Demands in AI

IV. Software for AI is Now Affordable and Understandable

V. A Basic Project in AI - Successful Approaches

VI. Introducing AI Into Class Projects

VII. Future Trends in AI - Directions for Our I Tech Programs

Presentation Time: 40 minutes

Information Online for Technology Education

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ABSTRACT

The information business is emerging as one of the nation's fastest growing industries. Relatively inexpensive computer and telecommunications technology has made online information retrieval possible. Today, students and teachers can quickly access, search, and retrieve information for education and research from online databases.

An online database is simply an organized collection of information stored in a computer system that can be accessed by another computer via the telephone. There are over 2400 online databases covering such diverse areas as education, travel, business, safety, engineering, ad infinitum.

Generally, databases fall into three categories: bibliographic, full-text, and online conference communications. Bibliographic databases provide brief information designed to help the user find the printed publication; an abstract is also often included. Full-text databases provide the entire document online, saving the user a trip to the library. The third category, online conference communications, such as electronic mail, allows the user to upload information to the host computer, as well as some search and download capabilities.

Information services provide users access to the diverse databases. To help users extract the information they want, the information services use software that is menu-driven, command-driven, or a combination of the two. Menu-driven software presents the user with a series of multiple choice questions designed to guide him/her through the search process. Command-driven systems allow the user more control over the search process by allowing the user to search the text of a record using logical relationships such as AND, OR, NOT. The search, "asbestos AND (school OR office)," would retrieve only those records that contain either or both of the words "school" OR "office" AND they must contain the word "asbestos."

The hardware and software needed to get online includes a personal computer, a telephone line, a modem, and communications software. Modems, the hardware that changes digital information from your computer to tones that can be sent over an ordinary telephone circuit, range in price from $50 to $500. Communications software tells your modem and computer how to communicate and can be very sophisticated. Good communications software can auto-answer, auto-dial, print or save incoming information, store telephone numbers

and passwords, even provide minor word-processing capabilities.

The cost of accessing databases ranges from free bulletin boards to services that are prohibitively expensive for use in education. Fortunately, some of the best database services offer substantial discounts to schools and educators. These include DIALOG Information Services, BRS Information Technologies, Dow Jones Information Service, CompuServe, The Source Telecomputing Corporation, Delphi, and GEnie. Rate structures for the services vary, so when studying a service's rates consider the following factors: 1) initial subscription fee, 2) monthly or yearly fee, 3) connect time (often varies by time of day used as well as at what baud rate), 4) telecommunications charges, 5) additional charges for printing records offline or occasionally for displaying records online.

You've probably said to a student or colleague, "I don't now the answer, but I know where we can find it." With online databases, the information you need for teaching, research, or consulting may be out there just waiting for your call.

Energy Literacy: Responsibility of Industrial Technology?

Dr. Thomas A. Singletary
Georgia Southern College
Statesboro, Georgia

ABSTRACT

The classical definition of energy is the ability to perform work. The importance of energy in our society cannot be overstated. This importance of energy as a commodity is further accentuated in our industrial society due to the legion of industrial processes that output, productivity, and standard of living are directly related to the availability and economics of energy as a commodity.

Technologists and Industrial Technologists have long purported that the utilization of raw materials for the well-being of mankind lies at the central core of their philosophy. A search of the 1986 professional membership of the National Association of Industrial Technology revealed that only twenty-seven professional members reported energy as being included as part of their teaching workloads. This extremely small number of professionals of Industrial Technology would seem to indicate that energy is not being currently included in the vast majority of instructional programs. Furthermore, the few programs reported by NAIT as offering academic majors in "Energy Management" reported very few, if any, students enrolled. The conclusion seems to be that the majority of Industrial Technology students and professionals are not including energy education within their programs of study.

This absence of energy education would not be as serious if such educational content were being included in the exact or social sciences, but such is not the case. The exact sciences seem to include some basic energy information in their programs, however, these programs are not a study of energy in its totality. Typically the exact sciences teach the definitions and/or the conversions of some energy quantitative units such as BTU's, calories, horsepower, and the like.

Believing the above energy education void to be true, in the summer of 1985 the author wrote an energy education institute proposal for possible initiation in the summer of 1986. This energy education proposal targeted the high school teachers of science, technology, and other related disciplines. The proposal was submitted to several energy related corporations through the Georgia based Citizens Advisory Council on Energy. The proposed energy institute included all tuition and a $50 cash stipend for all teacher-participants. Participants had to quality for admission to the Graduate School of Georgia Southern College and earned five quarter credit hours of graduate credit. The twenty-five director selected institute participants were primarily science teachers and represented some 23 Georgia counties dispersed throughout the state. Subsequent to reviewing the proposal, the Georgia Power Company funded the institute budget in its entirety and provided substantial support in other forms.

The institute director constructed an "energy literacy" instrument to ascertain the knowledge level of the participants prior to institute participation. This instrument was administered to each participant upon their arrival on campus for the institute. Out of a possible thirty multiple choice items, the participants scored an average of 13.9 or 46 percent thus indicating that they did indeed lack basic knowledge relative to energy. The same participant group scored an average of 26.1 items correct or 87 percent after completing the activities of the two week energy institute.

There is tremendous support available from energy related companies to enhance energy education thrusts. Such support can be found in the form of monetary grants, technical consultants, field trip coordination, printed pamphlets, audio visual materials, and numerous others.

Since it is evident that energy education is not presently being included in our educational curricula, I propose that such content be inserted within the instructional programs of Industrial Technology. This energy education content would serve to enhance the Industrial Technology discipline from both a relevance and uniqueness standpoint.

Managing Industrial Technology Programs in a Multi Purpose Academic Unit

Dr. Jerry Streichler, Dean
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Bowling Green State University
Bowling Green, Ohio

ABSTRACT

This presentation is organized around a preliminary survey of selected industrial technology programs. The data from the survey form the basis to discuss trends and related challenges to faculty and program leaders of baccalaureate level industrial technology programs.

Many academic units (departments, schools, colleges) in the field of industrial technology have emerged from industrial arts, or from engineering technology. Within these academic units, it is possible to find other types of technology programming in addition to industrial technology such as engineering technology or industrial teacher education. Histories of the development and evolution of these programs reveals challenges emanating from the interaction of these different curricula in such areas as courses and curriculum commonalities and differences, faculty development, faculty and program cooperation or competition, facility, equipment and resource utilization, selected aspects of accreditation and appropriate and effective service to clientele.

Upon reviewing selected situations and survey responses, a series of questions have been formulated to be answered in the session with audience participation:

1. Can engineering technology and industrial technology programs function side-by-side and under compatible terms within a department? Over time, will pressure to seek accreditation from different agencies be brought about by changing faculty interests?

2. As specializations in industrial technology programs mature, is there a tendency for faculty to move toward engineering technology and ultimately seek ABET accreditation and forego NAIT accreditation?

3. In locations where industrial technology and engineering technology are relatively large, how are both programs administered -- Within one department? Are two separate units formed?

4. Regardless of a unit's or program's history, where industrial or engineering technology or both are introduced, what is the effect upon the teacher education program? Should the teacher education program be maintained? In the same unit? By what means?

5. To which do central university administrators have a greater commitment -- engineering technology, industrial technology and or industrial teacher education?

6. Are the majority of technical courses required in industrial technology the same for engineering technology, industrial technology and for industrial teacher education?

7. Are faculty who were originally educated for industrial teacher education still lead or in the majority in industrial technology programs? What is the trend for staffing industrial technology programs? -- Teacher education doctorates? -- engineers? -- other individuals with masters degrees and various types of industrial experience?

8. What are the advantages and disadvantages to the industrial technology program when it is the only technology offering in the unit? In the institution?

9. What are the advantages and disadvantages to the industrial technology program when it is offered in an academic unit (department, school, college) that also administers other technology programs?

(9-a)

Microcomputer Graphics Animation: A tool for teaching Industrial Technology technical subjects

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ABSTRACT

Microcomputers are being utilized at an increasing rate and in a variety of applications. The many uses and potential of these fantastic technological marvels, however, have yet to be explored. The past half decade has seen drastic improvements in the capabilities of microcomputers combined with drastically reduced prices. The utilization and software development, however, has tagged along at a comparatively slower but steady pace. In fact, software development in some technical areas such as power mechanics, for example, has been very slow. One reason for the slower progress in the software industry may be due to the fact that software systems have to be designed for specialized, and normally smaller, segments of the market than the hardware systems.

The software developers, understandably, seek fields with a broader market first before committing to development of software for specialized fields. Also, software for specialized fields requires that the developer be knowledgeble in both programming and the area for which the software is to be developed. As a result, many of the software developed for specialized fields have been initiated by professionals involved in such fields, not by the vendors. To increase the self-sufficiency of the users and to encourage involvement of professionals in developing software, a growing list of utility software and tools have become available. Such utilities and tools reduce requirements for skill in programming, thus making it easier for many people to develop software for their own needs.

It is important for Industrial Technology educators to be familiar with the tools available for developing specialized instructional software, especially those that include computer graphics. The term computer graphics may imply graphics developed on computers only for geometrical and/or design purposes. Computer graphics, however, are also used in computer games and many other areas such as the recent usage in presentations to replace slides or transparencies. Realtors use computer graphics to present homes, floor plans, and other information. Most importantly, computer graphics can be animated, with considerable potential as an interactive instructional tool.

The use of animation for instructional purposes on 8 or 16 millimeter movie film is well known in technical areas. Popular movie animations on the operation of the automobile battery, ignition, and carburation systems are still avaiable in many media centers. Microcomputer

graphics animation can replace such movie animation, and provide interactiveness and flexibility at lower costs (although at a lower quality for some topics). Development of microcomputer graphics animation can be as easy as tracing a series of illustrations, then animating them on the monitor by drawing and erasing them in sequence at a fast speed.

The effectiveness of microcomputer graphics animation in teaching technical subjects was explored by using two methods of animation on two subject areas and on two different computer systems. In the first method, an IBM PC was used to animate the operation of a hydraulic pump. No special hardware or software was used; and all programming was done by drawing lines in white color and erasing them by redrawing on the white lines in black color. The results indicated that, while slow in presentation, the graphics illustrations for the operation of the pump were clear and more understandable than static slides or transparencies.

The second method employed the use of a Graphics Tablet and a special graphics utility program for an Apple (II series) microcomputer. Using this method, 16 mechanisms, including several four-bar linkages, were animated. The results were very successful in providing an interactive visual aid for presenting the operation of those linkages. With this system, developed mostly by students, the user is able to control the speed of the motions, or freeze the motion to study the position of the links. Similar methods have been successfully used by this author to animate over 2600 signs in American Sign Language for the deaf.

Subject areas such as electrical, electronic, and fluid circuitry are excellent candidates for computer animation. Mechanical systems, tool identification and operation of tools are also areas to be considered for computer graphics animation. In conclusion, it was observed that:

1. Technical subjects can be animated for presentation with minimal effort and cost

2. Students' skills and interest can be utilized in the development of the much needed software

3. Such software systems can be improved and modified more easily than can movie animation

4. Students are receptive to using and learning from such novel tools.

Robotics and the Future of Manufacturing

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ABSTRACT

Increased competition from foreign countries in every major industry has led the manufacturers and entrepreneurs in the United States in search of new and better methods for increasing the overall productivity of industry today. None of the big achievements in manufacturing today has had an impact such as the advancement in the field of Robotics. This impact has resulted in an increase in the job opportunities for people with expertise in the Robotics area. The future is even brighter for Robots in industrial environments. The importance of Robots continue to be widespread in the electronics industry, the aerospace industry, the manufacturing industry despite a slight decrease in its application in the automobile industry. The current trend in the manufacturing industry would indicate that the developments in the field of manufacturing are very closely related to the developments in the field of Computer Science. With the invent of faster computers and the availability of more memory and better storage facilities, as well as the tremendous amount of interest in software development for manufacturing operations, it looks as if the "Factory of the Future" is somewhere in the vicinity.

However, the future of Robots lies in it being integrated in the manufacturing field. As rapid as the development of Robots today, is the development of the technology surrounding it. An example is the Machine Vision technology. Machine Vision is an emerging technology and an integral element of the factory automation concept which embraces Robotics, CAD/CAM, CAE, FMS and numerous related sectors. But Machine Vision is just one related technology to Robots, a variety of other sensors would also be part of a highly intelligent Robot. The Robot of the future would be able to "sense" the environment, giving it better decision making capabilities, in coming up with its own plan in achieving an end objective (task oriented capability).

A still major role of Robots in the future would be the part it would play in a manufacturing philosophy like a Flexible Manufacturing System (FMS) or Computer Integrated Manufacturing (CIM). In this case, machines are not merely grouped together

but involve design of a flow process for production which would include CNC's, Robots, specialized devices, a sophisticated materials handling system, ASRS system all governed by a central computer which coordinates and controls the sequence and operation of each individual part to achieve the overall end objective.

It should be clearly evident that Robots are here to stay. Their importance can be clearly felt in every phase of industry, in any industry. Robots have certainly brought in some controversial issues. One of them "Impact on people". A common fear of the blue collar worker is the losing of a job to a Robot. But studies show that more than 50% of Robot technicians in the future would come from retraining or training older workers in the manufacturing field. Training is necessary in new areas of development and retraining is essential to keep up with the pace of advancements.

Robotics is still a very new field, and there are no universal agreements regarding its use, capabilities, limitations, and implementations, however there is little doubt as to its importance. The hardware breakthrough would eventually give the Robot the versatility of performing as precisely and as effectively as the industries need it. Multiple arm Robots are already on its way and variations in gripper design along with automatic tool changing capability has once again given rise to new hopes for the pessimist regarding the Robots future. The future of Robots lies with the future of developments like Computer software, Voice communication, Multiple arm coordination, Safety sensors, Programmable assembly systems, Robot communication systems, Vision systems, to name a few.

Whether viewed as a friend or foe, The Robot has found a niche in man's imagination.

Implementing Japanese Technology in the IT Curriculum

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ABSTRACT

It is essential to look at Japan for a model of productivity because the Japanese are still beating the U.S. at home as well as abroad. The key difference is management methodology. The U.S. educational system, both in schools and in industry, is not training effective managers. A significant part of the U.S. factory management comes from NAIT schools where courses are biased toward hard technology. In the U.S. most problems are solved with expensive technological answers because technical solutions are seductive. However, it is possible to solve most problems with inexpensive solutions. To understand these solutions we need to look at Japanese factory management methods. Japanese management has many similarities and some differences from U.S. management principally in the areas of employee relations and shop practices. In the U.S. the worker is considered an underling but in Japan he is considered an associate. Decisions are made and implemented at the lowest level because employees are thoroughly in-house trained and educated. Group effort is paramount. This is reflected in the fact that the Japanese have company unions. The economy is more stable leading to group solidarity because the Japanese government actively supports industry, the Japanese pick their markets and there is lifetime employment in the large corporations. Group thinking extends outside the company and vendors are an extension of the company. Internally, quality groups are very cohesive and these Quality Circles are vital to success. Quality is conformance to requirements and the goal is to achieve zero defects. In the plant the machine operator is the quality control inspector and there is copious use of automatic gauging. Success is achieved by identifying quality costs and work is done on nonconforming costs first because this brings high returns quickly. Quality concepts fit into the JIT (Just In Time) philosophy. JIT means parts are available the instant they are needed. Kanban is a simple system to tell when another part is needed. One result of JIT is that parts have to be perfect or production halts. Down time is low because maintenance is excellent and Japanese machines are continuously improved. The Japanese implement JIT before considering automation. Robots and automation are considered people-motivating management tools to keep workers satisfied and productive. Elimination of waste is the major goal and all WIP (Work In Process) is waste. A one half to one day inventory level is considered a realistic goal. The producton goal is a lot size of one. Producing few parts frequently will eliminate WIP. Without WIP storage is eliminated and therefore machines can be placed closer together. Smaller factories can employ product grouping, group technology, and cellular fabrication. The factory is balanced according to what is needed not what can be made because workers are interchangeable. Efficiency is achieved by reducing waiting time and setup time. One way to reduce waiting time is to deliver parts and tools to the

machines and use convenient transport mechanisms. Setup time can be improved by formalized work methods, use of mechanical aids, use of special teams for setup and the elimination of adjustments with stops and locating pins. Adopting Japanese soft procedures has eliminated the need for expensive robotics, automation and other hard technology in some plants. To see what was being offered in the U.S. the IT core courses of a sample of schools were examined and most were found to be similar. Texts books used in these courses did not include anything on Japanese methodology. It would be best to design a special required course on Japanese methods. However, present schedules do not allow for additional special required courses. The solution is to modularize Japanese methodology so it can be presented during regular lecture periods. Dedicated instructors are needed to lead the way.

Port Fuel Injected Turbo-Charged Engines

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ABSTRACT

Since the late 1960's vehicle manufacturers have been pressed to meet the ever increasingly stringent air emission standards set by agencies of the Federal Government. These methods started with the use of positive crankcase ventilation valves, and progressed later to air pumps, fuel vapor canisters, exhaust gas recirculation systems, readjustment of engine compression, timing and carburetion. The capstone of these devices is the nearly universal use of a three way catalytic converter in the exhaust system.

Primarily because of the Arab embargo on crude oil demand for better gasoline mileage also occurred at about the same time as the vehicle emission requirements. In 1978 the Federal requirement was for 18 M.P.G. fleet average and by 1986 the corporate average fuel economy had risen to 27.5 MPG a 129% improvement over the 1974 average which was 12 MPG. Many of the devices and tricks done to the engine to improve emissions were counter productive to the corporate average fuel economy.

In order to meet both the fuel economy and emission standards, it is necessary to control HC, CO, and NOx emissions while maintaining or increasing fuel economy and maintaining or improving performance and driveability. The best method to accomplish the above has been to turn to fuel injection with electronic controls and to improve performance while maintaining high fuel mileage the use of the turbo-charger has become common.

The electronic fuel injection system continually monitors such things as manifold vacuum, throttle setting, engine coolant temperature, intake air temperature, barometric pressure, and oxygen level in the exhaust. Few systems can as effectively minimize undesirable emissions while maintaining good fuel mileage as the port fuel injected engine.

The fuel injectors, connected to the fuel rail and mounted in the intake manifold at each cylinder, are actually electrically powered solenoids that open a short distance against a spring and allow fuel to be sprayed into the manifold. When electric current is supplied the armature and pintle move allowing a fine spray in the shape of a hollow cone to mix with air as it flows through the manifold. Most engines pulse the injectors once each crankshaft revolution although many other schemes have been used such as sequential pulsing and pulsing injectors in pairs.

A turbocharger is a relatively simple device consisting of a shaft with an exhaust driven turbine wheel on one end and a compressor wheel to force air into the intake manifold on the other end. No additional load is imposed on the engine while driving the turbine. The speed and output of a turbocharger is controlled by the design and sizing of the turbine wheel and turbine housing. Since the turbine and compressor wheels are mounted on the same shaft they rotate at the same speed (100,00 to 120,000 RPM). The turbocharger takes normally wasted engine exhaust energy to operate an air pump which increases engine volumetric efficiency. It is possible to safely increase the power output of an engine by as much as 50% with little change in engine components.

The cooling of the bearings in the turbocharger has been a design problem. All Turbochargers depend on a generous supply of clean engine oil to lubricate and cool the shaft bearings. Some turbochargers also employ engine coolant which is pumped through the turbocharger housing by the engine water pump. Most turbocharged engines recommend the use of SF/CD type engine oil and recommend changing of the engine oil filter at every oil change.

Turbocharger boost pressure is controlled by a "waste gate." If the boost pressure was not limited the engine could be subjected to higher pressures and temperatures than it could tolerate. The boost pressure is usually controlled to a boost of about 9-12 PSI above atmospheric although during snap acceleration momentary higher levels may be allowed to occur. The "waste gate" is actually a by-pass valve that allows some exhaust to by-pass the exhaust turbine wheel which slows the shaft and compressor wheel therefore reducing boost.

The computer has been in use since 1981 in American cars. Various input sensors such as the engine coolant sensor, oxygen sensor, throttle position sensor, speed sensor, etc., are used to tell the computer the operating mode of the engine. Output devices such as the spark advance schedule, fuel injector pulse width, exhaust gas recirculation valve, turbo waste gate control, and cannister purge are then controlled by the computer to provide the engine with the optimum conditions to give the best driveability, fuel economy and emission control so far possible.

Many computer controlled electronic fuel injection systems have what is commonly called an adoptive memory. This system is capable of compensating for fuel system changes resulting from production tolerances and changes in the engine as it develops wear over its lifetime. These systems have the ability to "learn" and to adjust the system to better fit a certain engine.

Most computer controlled systems have some type of on-board diagnostic ability. The logic module continuously monitors its own input and ouput circuits. Each circuit is checked for the correct operating range and if the circuit falls out of the pre-programed operating range the logic module will consider this to be a <u>real</u> problem and will store the fault into its memory. Most logic modules will erase the fault from its memory if it does not see the fault return for a certain number of engine starts-commonly 20 to 30 engine starts.

If the logic module locates certain faults that it considers essential for good operation, the module will turn on a warning lamp to alert the driver of the problem. The logic module will attempt to keep the engine running by substituting information from other sources or by switching to a pre-programed program. This mode of operation is sometimes referred to as the "limp-in mode."

The turbo charged fuel injected engine provides excellent fuel economy, excellent acceleration, and performance, while maintaining government mandated exhaust emissions.

The Implications of the Construction Industry Cost Effectiveness Project Report

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In 1978 the Business Roundtable sponsored study teams to analyze the problems facing the construction industry mainly the rapidly rising costs of construction. The Construction Industry Cost Effectiveness Task Force spent the next four years organizing, collecting, and studying data and information related to construction. Since 1965 the construction industry had been witnessing a 3% decline in productivity per year and by 1980 this decline had reached 8-10%. The industry was rapidly pricing themselves out of business. The purpose of the CICE study was to attempt to find answers to run away construction costs. The CICE eventually published 23 reports plus a summary report on various aspects of the industry. Each divisional report addressed specific problems and makes suggestions for improvement. Since 1982 when the reports were first distributed the by word of the industry has become "higher productivity".

The report under the heading of A-5 Management Education and Academic Relations has specific implications for higher education. In general the following findings were the more significant finding of the study.

1. "Owners and contractors often differ on their preference of educational background for their project managers and construction managers (owners generally prefer a bachelor of science degree in engineering; contractors, a degree in building construction). However, both agree on the need for a combination of technical skills and construction management courses."

2. "Undergraduate courses need to be upgraded and standardized. There is a serious question of a four-year engineering program meeting the needs of the construction industry."

3. "Industry-academic relationship must be strenghtened."

4. "Industry needs to increase substantially its financial support of academic institutions including specifically designating funds for construction programs. Needs vary among schools and include scholarships, research grants, summer jobs for students and faculty, guest lecturers, and rotational assignments between construction industry personnel and the academic community."

5. "Continuing education is the best short-term answer to strengthening the construction education process."

6. "Construction must be promoted as a profession to attract top quality students to the industry."

7. "Most companies favor formation of a professional construction organization on a regional basis to improve the industries relations with academia."

8. "More coordination is needed among the numerous professional and industrial societies already active in construction education."

Construction programs have a related role to these findings as well as a responsibility to help correct the problems of the industry that university graduates are directed toward. Greater cooperation between education and the industry is needed but ultimately more involvement on the part of contractors and owners will cause this cooperation to grow. Greater involvement on the part of both parties will eventually lead to correcting some of the issues outlined in the report.

Beyond the issues of the report, higher education must work at strengthening ties with the industry by attending industry functions, association meetings, developing construction industry advisory committees, creating cooperative education or internship placements, and working to make construction a recognized discipline leading toward professional employment. Many of the higher eduction institutions have committed themselves to addressing CICE findings. We must all work toward inproving construction curriculums to reflect current industry needs and help correct or eliminate industry related problems.

Expert Systems in Industrial Operations Management

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ABSTRACT

It began just after the Second World War on both sides of the Atlantic Ocean. U.S. & British scientists embarked on the pursuit of making machines reason and behave like human beings, i.e. the conceptual development of artificial intelligence (AI). This was the era of thermonic vacuum tubes, pre transistor, and the word "microprocessor" was not even coined! The task for those scientists was formidable. However, with the rapid developments in the field of electronics there has been progress in the field of AI. One has been the evolvement of expert systems (ES). This paper will delineate expert systems and the implementation of ES in industrial operations management.

Research into AI has been a multi-billion dollar endeavor. However, the results from this effort have been less than spectacular. One of the major obstacles in AI research is that AI strives to emulate the human mind and human intelligence. Except! we really do not know how the human mind works, nor do we know of human intelligence processing! Even the prevailing theory of the human brain hemispheres controlling certain limited intelligence functions has been disproved. Douglas Hofstadter describes the many enigmas of intelligence in his Pulitzer prize winning book "Godel, Escher and Bach". He substantiates that any entity has a special relationship with itself, which keeps the entity from acting on itself the way the entity would act on any other entity. A foot cannot step on itself, an eye cannot see itself, similarly the mind is nebulous of the thinking of thinking. Thus the relationship of knowledge to knowledge is not knowledge of knowledge, but metaknowledge. Metaknowledge is one of the obstacles to AI researchers. In fact AI is a enigma, and has provided little if any real world applications. Nevertheless, the major contribution of AI has been the development of ES. These ES are a huge commercial success.

While AI attempts to emulate the thinking of human beings, an ES only attempts to reproduce the expertise of a human specialist. Obviously, ES is undertaking a very narrowly defined task. That is one reason why ES are so successful. Furthermore, unlike AI, ES does not attempt to simulate human thinking, it only attempts to cogitate like an expert when he or she is solving a specific problem.

Initially, it was presumed that ES in Industrial Operations Management (OM) would have to comprise a

profusion of knowledge. That would have made popular personal computer based ES impractical. However, those initial apprehensions have been alleviated due to the:

a. Development of more powerful microcomputers, with larger main and mass memory systems;

b. Software development, i.e. more proficient ES, especially with paging techniques;

c. The discovery that most OM decisions did not require legions of information.

In utilization of ES to OM the preceding reality was significant. Not only did this discovery define the type of problem that ES could be applied to, but it also defined the actual decisions made by operations mangers! It is axiomatic that OM requires specialized knowledge. However, the types of OM decisions that propel "management" are not big decisions, but are small, tedious and repetitive decisions. These OM decisions are typically in negotiations, sales, establishing budgets, maintaining inventory levels, low-level investments, etc., which could be handled via ES systems.

Two years ago, expert systems in industrial operations management were no more than an academic curiosity. At present there are over one hundred ES for OM applications. A few of the areas where ES are prominent include:

1. Financial statement analysis for investment suitability of a company.

2. Export analysis, to guide the user through the complicated process of applying, getting approval, and using an export license from the US government.

3. Negotiation Strategy. To assist management in negotiating tactics and strategies.

4. Expert Sales. Thus any manager can be an expert in specific customer preparation strategies, specific customer presentation strategies, and closing strategies.

5. Expert resource allocation. This program will evaluate the alternate allocations for optimal mix.

An expert system is a computer program. It will emulate the rationality an OM expert uses in resolving a specific problem. Thus a nonexpert can use the OM knowledge and the reasoning proficiency attributed to an OM expert.

"Team Building Technology: Transferring the 'Spirit' of the Best of International Management Technology"

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ABSTRACT

Technologists are constantly looking for ways to create the environment where they and their organization are more effective and efficient--or in a word, more PRODUCTIVE. Various technologies assist in this process of becoming more productive. Robotics, FMS, QWL, Kanban, and SPC are productivity enhancement tools that have been proven in a variety of settings. The "soft technologies" employed to enhance the contributing link of people through involvement, creativity, problem solving, and relationship building enhance these "hard technologies" of productivity improvement, and they enhance productivity not by a percent or two, but often by tens and hundreds of percent. In the '80's and '90's, it is apparent that much of the gains in productivity will come through people and that one of the major technologies to accomplish this is management technology and more specifically the technology of team building.

The roots of team building technology are uncovered and examined. The cultural, geographic, and organizational development (OD) base of team building with an emphasis on the Japanese (Nippon Maru) approach and the myths of why Japan can and we can't are used to illustrate the unique U.S. implications. A comparison of organizational development in Japan and the U.S. on the dimensions of history, approaches, resources, values, technical personnel utilized, diagnostic tools, and interventions is given which offers targets for strategies that can be employed to enhance any OD effort, especially team building. The role of knowledge (chishiki) and information (joho) as foundational to team building and the initiation of a team building technology through harmonizing utilization of competence in the areas of power and interpersonal sensitivity (jitsuryoku) are explored as some of the key approaches of a technical manager wanting to use team building to increase trust, loyalty, and productivity.

Data and insights into the current Japanese managerial environment that illustrate effective opportunities for U.S. managers to learn from what 'Maurie' Kaoru Kobayshi calls "the most misunderstood country" (Japan) are outlined. U.S. managerial idolizing or ignorance of the past, present, and future Japanese managerial technologies is one of the biggest roadblocks to building the most effective "team" for the next round of "the games."

A process oriented rationale for team building is supported by the motivational needs of both the individual and the organization, and data associating team building effectiveness with "bottom line" measures of productivity is illustrated. The relationship between the management technology employed and the productivity of the organization is enhanced by appropriately applied team building technology. Team building assessment instruments that have been successfully used with a variety of organizational clients illustrate the components of the team building technology. Specific examples of effective team building technology implementation along with a six-step technique of team building are described. Those steps are:

1. Assessing the need for a team effort.

2. Obtaining input from individuals and groups on the nature of the team and its members.

3. Defining the team membership and general purpose of the team.

4. Building, fixing, enhancing, and adjusting relationships and establishing the specific goals of the team.

5. Improving the team members' skills in team technology (e.g. skills, behaviors, communication, change, conflict, competition, and creativity).

6. Caring and feeding of the team.

Integrated Technologies

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ABSTRACT

The educational process has been affected by computers in many traditional and isolated ways. Computer science programs teach the technology of computers and the art of data processing. Computer-based instruction can be applied to nearly any traditional educational content, and can range from high level problem solving tasks to a mere substitute for text book drill and practice. The process of INTEGRATING the computer with the educational process is more complex than the instructional methodologies cited earlier. Progressive educational programs might utilize computers in math and logic classes, for computer-aided design, process control, or project planning and coordination. The remaining challenge to education is to truly INTEGRATE the computer as a tool, using it for a variety of applications while subsequently drawing linkages between many varied technologies.

Industries who have been successful at computer integration all agree that the most critical factor is to have, in concept, ONE data base. This insures that data will need be entered only once, and that all users will access exactly the same data. In an manufacturing environment, a draftsman might create a CAD drawing, designers could review the design, engineers can perform analysis of the design, purchasing can extract bills of materials, planning can determine net materials requirements, manufacturing can produce the product, management can review production related data, and documentation can create end user documents; with all personnel sharing the same data base.

In practice, no single computer system can perform all of the data keeping and processing tasks in a large industry or educational institution, hence it becomes critical to consider communications between computer systems. The popular approach to communications today is 'Networking' which allows many computer systems to communicate at high speed, and if standards are considered, might allow different brands of computers to communicate with each other. At least four distinct phases of learning must take place in order to achieve computer integration:

- Systems personnel must learn the basic capabilities and operation of the computer hardware, and the functional features and limitations of the operating system. Users

must learn a modest subset of the operating system.

- Users must become proficient with the applications software, and must begin to identify and analyze the specific tasks which will be of greatest benefit to solving their business problems.

- The users must then begin to apply the hardware and software tools to their business problems. If this step happens too early, it is likely that many fundamental mistakes will be made, effort will be lost, and some problems may never be overcome.

- The final phase is to evaluate the success of the project and to verify that the quality of the product is maintained or enhanced due to computer integration.

Further consideration must be given to future enhancements and the growth potential of the computer system. Most often users adapt to the computer quicker than anticipated, and the demand computer resources grows exponentially.

No matter how good a computer system is the users can easily defeat the efforts of the best planners, and conversely no matter how bad a system is the users can make it work. Many institutions invest in capitol equipment and software, but do not invest in the potential users of the system. Educational programs and incentives must be devised for users, and time and patience must be given if integration is to be successful. A computer system, like any other tool, is of no value without people who are dedicated to making it work.

CAD Education Utilizing The Macintosh Computer

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ABSTRACT

INTRODUCTION

This presentation will review the Computer Aided Drafting potential of the Macintosh computer with implications to the educational environment. It is designed as an introduction to the Macintosh computer with a review of current CAD software packages. The tutorial will also cover related hardware and software useful in the overall education of today's engineering student. The presentation will be divided into the following segments:

Attributes of the Macintosh computer for CAD education
Demonstration of the Apple Macintosh operating system
CAD software considerations and choices
Demonstration and tutors of selected Macintosh software packages
The future as related to micro based CAD systems

BASIC EQUIPMENT CONSIDERATIONS

The general acceptance of the Macintosh as a CAD tool has been divided into two distinct camps. Those who favor the machine often seem fanatical about it's possibilities and scoff at anyone who would dare to deminish it's potential. Others seem to regard the computer as a whim or toy. Each reaction exists on the extreme of reality. A more realistic approach would indicate that the potential of this machine is certainly nothing to scorn. This segregation of thoughts in no way aids the difficult choices required by today's CAD educators, who are forced to make many important decisions with long range implications.

In summary the Macintosh computer possess many of the current hardware requirements necessary for the production of CAD presentations in both the education and business environment. The new and unique approach of a CAD type input device--the mouse--combined with pull down menus, and similarity of operating procedures from application to application provide some ideal features to teach CAD.

FUNDAMENTAL CAD SOFTWARE REQUIREMENTS

Currently there seem to be two general routes taken by software developers. They either are or are not IBM compatible. Consider non-IBM packages to be somewhat of a risk, since the success of the CAD package is determined not only by the success of the package itself but also by the success of

the supporting hardware. A software package that could be run on a variety of machines would have a definite advantage. This brings up the point that the Macintosh is, first of all, not an IBM. Second, Macintosh software will not run on anything else. These points may explain the late startup of full fledge CAD software packages for the Macintosh. The following CAD type application packages would be considered minimal for a Macintosh based system and will be discussed during the presentation:

MacPaint by Apple Computer
MacWrite by Apple Computer
MacDraw by Apple Computer
MacDraft by Innovative Data Design Inc.
MacPlots II by The Computer Shoppe

Additionally the EZ Draft CAD/CAM/CAM package by Bridgeport Textron Company and/or Professional CAD for the Mac by MGM Station should be considered when an absolute full blown CAD system is essential. Cost and experience with the aforementioned packages should be considered before the substantial investment is justified.

Evaluating the various CAD software packages is indeed a formidable task. The competition is furious for this emerging technology. Many companies fall by the wayside each year and others are reaching the level of long range profit potentials. The dominant CAD software package will be determined within the next five years. Every effort must be made to choose software that will succeed. Long range company support is mandatory to keep up with changes that will occur over the next few years.

THE FUTURE

What the distant future will hold is truly exciting to think about. It is the hope of this author that CAD equipment and software companies alike will continue to consult with educators and provide substantial grant possibilities for development. CAD educators as a rule are eager to share their needs and desires. The entire desk top of the future engineering work station will be a barrage of information possibly approaching the paperless office environment. Designers will sketch, design , think, and calculate on systems which will displace typical draftpersons to some extent. Perhaps a portable engineering workstation Dynabook will be fourthcoming. CADD will be the standard for drafting. Drafting tools of today will take the route of the slide rule.

The future of Macintosh CAD would seem to center around developments in both hardware and software. The recent announcement of the Macintosh Plus with its SCSI port will undoubtedly open up an entire new flow of third party hardware because this port provides the open architecture not previously available. Software developers will have a field day with the present megabyte of memory.

Upgrading Technical Competency By Shadowing

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ABSTRACT

A rather significant concern of those involved in the preparation of individuals for employment in industrial technology is how to assure that the educator's background is current with practices in the field. In a discipline that sees new developments almost daily, keeping current presents a real challenge. The professional educator finds it necessary to utilize a wide variety of techniques, and no one technique will do the job. A number of techniques have proven effective and been utilized: textbooks, product promotional literature, professional publications, conferences, seminars, workshops, summer employment in industry, sabatical leaves, funded projects, industry/educator exchanges, and there may be more. Each of these techniques has strengths and limitations, and have been utilized in varying degrees.

The purpose of this presentation is to examine another technique: "Shadowing". This technique is defined as: A process for up-grading technical competence in a field of specialization by accompanying an employee of a firm as they perform the job skill or process in which the "shadower" desires to gain new or additional expertise. This typically involves little, if any, hands-on experiences for the "shadower".

In a review of the literature, little or no information was found concerning the shadowing technique; even under other titles. The technique offers a number of unique and advantageous characteristics, and should be given consideration when a means of updating technical competence is sought. The unique and advantageous characteristics are identified as:

1. The experience takes place in a "live" work atmosphere.
2. Industry is not asked to provide a paid work position.
3. May be used in a wide range of industrial settings.
4. More advantageous for up-grading knowledge, as apposed to learning a new skill or process. (Limited hands-on experience)

Because of the limited information found in the literature, a survey was conducted to determine the extent to which shadowing was, or had been utilized among industrial technology educators. A survey form was mailed to the chair of each of the 139 programs listed in the 1984-85 Program Directory of NAIT. A response was received from 80 of the 139 programs, and of these 80 programs reporting, 12 had faculty who had utilized the shadowing technique as a means of updating their technical competence. These individuals had used the technique from one to four times, with one individual reporting twelve times. Most of the shadowing experiences were completed during the summer months,

with two reporting they used semester break time, and two were sabatical leave experiences. The length of time spent in the experience ranged from one day, one week, one month, several weeks, to as much as the academic year. There was also a wide variety of industries used in the experience. These involved firms associated with: manufacturing, construction and architecture, electronic component assembly and fabrication, printing and photographic supply, and plastic molding.

The most frequently reported technical competencies updated during the shadowing experience were related to the management type activities. These included: statistical quality control, process control, facilities and inventory control, just-in-time stock, union/management relations, safety, estimating, scheduling, and record keeping. Experiences which involved hands-on skill development were limited and included: CAD/CAM applications, robotics, equipment calibration and repair, and photographic darkroom processes.

Arrangements with the industrial firm for the purpose of conducting the shadowing experience were most frequently made through members of the institution's Industrial Advisory Committee. This individual then made the necessary arrangements at the industrial firm and assisted the shadower in planning the sequence of experiences desired. In some cases security clearances and liability releases were required.

Benefits derived from the experience were diverse, but generally were related to the concept that it greatly expanded the shadower's understanding of management techniques; an understanding that could not be obtained from textbooks or workshops because the experience was live and real. The experience was also seen as a personal confidence builder, an excellent industry/education relations builder, and a creditable basis on which to modify and build curriculum and course content.

Limitations or concerns associated with the shadowing technique were minimal, and related to getting the institution to recognize the value of the experience and provide funds to compensate the shadower. There was also concern for finding the time to organize and conduct the experience.

In summary, it would appear that the shadowing technique can be a very positive and efficient means of upgrading the technical competence of those individuals involved in the preparation of industrial technology students. The experience can be planned for short or long term, conducted in large and small firms, and doesn't require the shadower to be a productive employee, nor does it require the industrial firm to create a work position for pay. Education and industry both benefit from this type of experience, and the student, the real benefactor, is assured of an educational experience that is relevant.